A WINDOW OPEN ON THE WORLD

The UNESCO Courier

FEBRUARY
1959
(12th year)

NOBEL PRIZE WINNERS' ROUND TABLE

SCIENCE & MANKIND

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People foolishly think that if they ban the hydrogen bomb they have finished. Make no mistake., if a war starts, every hydrogen bomb and every weapon of war will be thrown in. The only way to save humanity is to ban war itself.

— Lord John Boyd Orr,
Nobel Peace Prize

★

It is clear that with thermo-nuclear weapons a total war is not feasible any more. It would amount to mass suicide or mass murder. But there is a more insidious danger and that danger is the so-called small tactical atomic weapon. Such a weapon is of a size comparable with the Hiroshima bomb. It may be a quarter the size but it is several hundred times more powerful than the largest block-buster of the last war. Such a weapon must be a fission weapon and cannot be "clean". By its very nature a considerable area of the ground would be contaminated by the radio-active fall-out. To talk of such weapons as "small tactical weapons" is to deceive the public.

— Homi Jehangir Bhabha,
Chairman of the Indian
Atomic Energy Commission

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12TH YEAR

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COVER PHOTO

What structural changes occur in uranium when it is subjected to immense heat in a nuclear reactor? To help science to answer this question an American company built the plastic models of the crystal structure of uranium shown here, together with the special measuring equipment used by the scientist studying the models.

USIS

"In general there are now two groups of people in the world: those full of hope but living in poverty and those enjoying prosperity yet haunted by fear of the future. Perhaps science will furnish the means to break this hellish circle... If we are rational, if we achieve freedom through science, then, carried onward by it, we may perhaps taste the pleasures of culture, promised to all men yet still far from accessible to all. This thought itself should be like an open wound to us for we could never, without a pang of conscience, take pleasure in even the finest of cultural things while knowing that there are millions of men and women in the world who suffer from hunger."

In these words, Professor Gaston Berger, the eminent French psychologist, concisely summed up the problem and the promise of science and society in our day. Professor Berger, who has been called "a bridge-builder between the social sciences and the exact sciences," was participating in the International Round Table of world-renowned scientists which recently debated the vital question, "Man and Scientific and Technical Progress," in Unesco's new headquarters in Paris.

"Unesco," Professor Berger told the audience in the great Conference Hall, "is far more than an organization whose job it is to provide technical and financial aid for a certain number of scientific, educational and cultural projects. Unesco must stimulate the efforts of others, bring about meetings, call up new ideas. In a world of constant change it must be in the vanguard of research and invention. And in the same world, restless, disturbed and fearful, it knows too that it must be a pillar of great moral strength.

"To justify the hopes that men place in it, Unesco keeps a double goal in view. It can and must turn to the most eminent men in every field, yet it must never forget that it is at the service of all men: on the one hand the scientists, artists, writers and great teachers; on the other, the immense numbers of men and women who aspire to knowledge, who have a right to culture and who must be given access to education. Between the two Unesco lays down its bridges."

Today, technology and its creations are no longer the exclusive realm of engineers and industrialists. They are part of the everyday scene, of immediate concern to all of us. How are men and women to adjust themselves to the impact of science and technology on their lives?

Educational programmes and broad campaigns publicizing the work of scientists and technologists could do much to make the ever-expanding frontiers of scientific knowledge seem less remote. And the value of a broad appraisal such as that made at the Unesco Round Table lies in its ability to bring into perspective for the man-in-the-street the vast new world which the triumphs of science and technology are creating for him. That too is the purpose of this issue of The Unesco Courier, entirely devoted to the debates of the great scientists at the International Round Table.

Science, Technology & Man

NOBEL PRIZE WINNERS' ROUND TABLE

Today, science and the tremendous technical advances it has made possible are reshaping our lives at an overwhelming speed, bringing both benefits and hazards, constantly posing moral, economic and social problems.

In Paris recently, eight world-famous scientists, five of them Nobel Prize winners set out to explore the ever-advancing frontiers of today's science and technology and to examine some of the problems created by the increasing pace of scientific conquests, at an International Round Table debate on "Man and Scientific and Technical Progress".

Seated at a "Round Table" set up under the immense shell of reinforced concrete housing Unesco's new Conference Hall, these top-ranking scientists were taking part in what was probably the most important event of "Unesco Month", a succession of scientific and cultural events organized on the occasion of the inauguration of Unesco's new Headquarters and Unesco's Tenth General Conference.

During three remarkable evening meetings vital questions arising from the impact of science and technology on human life were discussed by members of the Round Table whose debates were also followed on the third evening by radio and T.V. audiences in many European countries.

In this issue we present significant passages from the debates of the International Round Table, beginning with the introductory remarks of Lord John Boyd Orr, Great Britain, who presided at the meetings (see opposite page).

LORD BOYD ORR

The men of science who are here do not represent their governments. They come here as scientists and the only master that a scientist knows is the truth. What will they speak about? They are going to discuss the advance of science and the effect of science on human society.

It is the advance of science, leading to technology and to the birth of new ideas, which has guided the full evolution of our civilization. Every advance of science demands and brings about some change in the structure of human society. Thus civilization has advanced in the last 10,000 years, adjusting itself to these changes, sometimes with difficulty, but managing to survive.

The problem of the present day, however, is that in our generation science has advanced at an accelerating rate. In the last 50 years science has advanced more than in the 2,000 previous years and in this advance has given man enormous new powers. Physicists tell us they have produced the hydrogen bomb, which makes war impossible. No great power can now declare war on another great power with these instruments of death and destruction without committing suicide.

The advance of modern technology has also enabled us to produce in abundance everything that mankind needs. Let me give you an illustration. In my day we have had two world wars when science and technology were geared for destruction. And since the last world war a third of national incomes has been devoted to armaments. In spite of that destruction, in spite of that diversion of wealth to armaments which gives no rise in the standard of living, the standard of living today in the industrialized countries is very much higher than in 1914.

In biological science it is the same and in agriculture the greatly increased yields per acre, and per annum enable us to produce food in abundance. The problem of today is totally different from the problems of the 19th century and earlier. Today we can produce goods in such abundance that the problem is how to get them distributed and consumed so to prevent an accumulation of surpluses and resulting unemployment.

In medicine there has been the great conquest of disease. Medicine has enabled us to control the great killing diseases, with the exception of one or two, like cancer, to cure them and in most cases to prevent them. What has been the result? Great expansion in the length of human life. Twenty to thirty years of increased life to every child born today is a greater gift of modern science than the gift of the hydrogen bomb.

In the past, hunger and disease limited the growth of population. Today hunger can be abolished, disease is rapidly being defeated and we are having an explosive rise in population. This is one of the problems we shall need to deal with. Thus, you see, the advance of science has driven us into an entirely new age—an age where war is impossible. That is the biggest revolution which has ever taken place since the beginning of civilization.

Can we adjust ourselves to that? It has changed the age of inevitable scarcity, with poverty for the majority of mankind, into a new age of potential abundance for everybody. Can we adjust society to these great new changes? It is not so easy. Jet planes have made the world so small and they have made the affairs of all countries so deeply, intimately interlocked that the whole world has to change before any single country can survive and adopt these changes. Can we adjust human society to these great changes? Some people think we cannot. I believe we can. But it depends upon whether the people of the world realize what it is we have to face up to, and to make it possible for our governments to lead us to a wonderful new age.

JOHN BOYD ORR (Great Britain) has spent a large part of his career as a scientist fighting man's battle against hunger. As a doctor and agronomist, he has devoted special attention to problems of nutrition and agriculture on a world scale. From 1945 to 1948 he was Director-General of the U.N. Food and Agriculture Organization. In 1949 he was made a peer and was awarded the Nobel Peace Prize. Lord Boyd Orr is a member of the Royal Society and a was formerly a Member of Parliament.

GASTON BERGER (France) is a distinguished philosopher and psychologist and the author of many authoritative works especially in the field of characterology. A Member of the Institut de France, and President of the International Institute of Philosophy, Gaston Berger is also Director-General of Higher Education in France, and President of the French National Commission for Unesco.

NIKOLAI SEMENOV (U.S.S.R.), winner of the Nobel Prize for Chemistry, 1956, is one of the world's leading authorities on the chemistry of chain reactions. His theories on simple chain reactions and on branching chain reactions have had a profound effect on chemical thinking. He is a member of the Praesidium of the Academy of Sciences, Moscow, and Director of the Academy's Institute of Physics and Chemistry.

DANIEL BOVET (Italy) was one of the discoverers of the sulphonamides and is one of the world's leading authorities on synthetic curares which play important roles in surgery and in physiological research. He is head and founder of the Therapeutical Chemistry Laboratory at the Institute of Health in Rome. Daniel Bovet was awarded the 1957 Nobel Prize for Physiology and Medicine.

BERNARDO ALBERT HOUSSAY (Argentine) winner of the Nobel Prize for physiology and medicine in 1947, is one of the creators of endocrinology, the science of hormones. His research work in internal secretions and his studies on diabetes have brought him wide recognition. A member of the Argentine Academies of Medicine, Letters and Sciences, and of the National Academy of XL in Rome, Bernardo Houssay is now Director of the Instituto de Biologia y Medicina Experimental, in Buenos Aires.

WILLIAM ALBERT NOYES (United States) a distinguished educator and scientist who is widely known for his work both in physical chemistry and international affairs. Vice-chairman of the Committee on Space Research of the International Council of Scientific Unions, he is also a member of the Executive Committee of the International Union of Pure and Applied Chemistry. In 1957 he was awarded the Willard Gibbs Medal, one of the highest awards which can be made to an American chemist.

P.M.S. BLACKETT (Great Britain) is one of the world's greatest authorities on cosmic rays and in particular on electronic showers. He has recently carried out research on new fundamental particles of matter. President of the British Association for the Advancement of Science (1957-58), Professor Blackett has been called the "father" of "operational research" (the technique of providing executives with the scientific basis for practical decisions). A member of the Royal Society, Professor Blackett received the Nobel Prize for Physics in 1948.

HOMI JEHANGIR BHABHA (India) has gained great distinction through his original research in theoretical nuclear physics, and in particular on the quantum theory and on cosmic radiations. Director of the Tata Institute of Fundamental Research, Bombay, and Chairman of the Atomic Energy Commission, Government of India, since 1954, Homi Bhabha was president of the first international conference on the peaceful uses of atomic energy, which was organized at Geneva by the United Nations in 1955.

AT THE PORTALS OF A NEW AGE

We are at the portals of a new age. A new world is coming into being before our very eyes yet men seem unaware of it. This, then, is the message which science has for man: you are witnessing the birth of a different kind of world, a world in which there are new duties and responsibilities. For we are not advancing towards an era of assured peace and tranquillity. Before us lie unknown dangers, undreamed-of adventures and countless inventions – the embryos of countless others.

Disquieting, but grandiose and full of promise – that is the new world towards which we march. True it will bring with it a host of new problems as does every phase of human existence: adolescence, when the child becomes the man, the ripe years of maturity and finally, old age, when hearts and minds are opened to wisdom. Science has faced man with the challenge of fresh problems. Can it help him to resolve them? Can it aid him to make the best use of the resources it has created for his benefit? These are the momentous questions to which we must reply.

Gaston Berger

P. M. S. BLACKETT

SCIENCE CAN CLOSE THE GAP BETWEEN RICH & POOR NATIONS

If we look at the future of science, it is quite useful to distinguish what I may call the three faces or the three aspects of science.

The first is science as a creative scientific research worker sees it and feels it. It is an activity of intense value and attractiveness in its own right, and, necessarily, only a few people at any one time in the world can be right in the forefront of advancing fundamental knowledge, just as very few people can be the first to climb Mount Everest, the first to cross the Antarctic or the first to go under the Arctic ice. But this is an activity of the practising of pure science, whether experimental or theoretical, which taxes all the skill of mind and skill of hand and is invaluable as an experience.

The second aspect is science as a body of knowledge. This body of knowledge created up to date by centuries of patient work by thousands of scientists of all countries of the world must rank as one of the greatest achievements of the human mind and ability, comparable to the greatest achievements in art and literature. Now this body of scientific knowledge which has great beauty in itself can be appreciated by anyone of any nation who takes the trouble to learn its language.

The third aspect with which we are mostly concerned here, I think, is science as power over nature. Science is the force which has changed the world ; the whole structure of society has been changed and in a relatively short time—in fact, in the last 200 years or so. Now in this process, the changing of the world by science, there are various distinct steps which it is extremely important to keep in mind.

Firstly, there is the fundamental discovery which is often part of the structure of pure science. Then this work has to be applied to some definite, practical objective. The pure scientific discovery is very often made by someone with no interest in applications at all—very often the best pure scientists have no interest—but to be useful it has to be applied. Then we get the era of applied science leading on to development work, and, finally, to exploitation in the practical making of the goods of life ; either making much cheaper the old goods of civilized life (clothes, houses, baths, foods and so on), making them available to a very much larger number of people than in the past, or by producing entirely new things such as motor-cars, aeroplanes, television, which had never existed before.

Europe's wealth increased tenfold

Now, that is the last stage in the process and we must keep these stages distinct—the fundamental science, the applied work and the final exploitation—because it is in this distinction I think that important consequences lie.

I think that if one does accept this distinction, we should make this point. What the governments of countries spend this immense amount of money on, the 1 per cent of the national income, is applied science for its material benefits for mankind. That is the object of the expenditure, and it is a vast activity nowadays. It is an enormously profitable investment for any country, and the high standards of life of the rich countries depend on this investment in science, the cheap part being the pure science and the most expensive part being the actual application to real human needs.

An astonishing achievement of this scientific revolution has been to increase by a factor of ten in 150 years the wealth of Western European countries. But, looking round the world today, we see that these great material benefits of science are very unevenly distributed over the world as a whole. Although the knowledge of science is widespread, the material benefits are extremely unevenly distributed, and I think it is this uneven distribution of the applications of science which today provides man's greatest challenge.

(Here, Professor Gaston Berger of France, describing Professor Blackett as the "father" of "operational research", asked him to describe how this technique could make a scientific contribution to the world of tomorrow.)

I am glad that this question of "operational research" has been raised as I am intensely interested by this technique which was brought into being to assist the efficient prosecution of the war, and which has been aptly defined as the technique for providing executives with the numerical basis for practical decisions.

Rich & getting richer all the time

We all, as citizens of our various countries, are indirectly executives by controlling government actions in the long run, and so it is very apt at this point to know what is the numerical basis for the statements that, for instance, I have been making, and other people have been making, and what are the figures we ought to know if we are going to do something about it.

I think that the essential figures which one has to appreciate to understand the magnitude of the problem are quite simple. Something like one quarter of the world's population of 2,500 million or so live in what can be called rich countries. These people have an income per head of about $1,000 a year. They comprise, of course, most of Europe, the United States, Canada, Australasia and so on. Then on the other extreme, there are between one half and three-quarters of the peoples of the world who are definitely excessively poor and who have an income per head of about a tenth as much as the rich countries: $100 a year, compared with $1,000 a year of the rich countries. Thus there are at least three people with the low income for every one with the high income.

This is the famous gap between the "have" and the "have not" countries. Moreover, the rich countries are getting richer at an average rate of about 2 per cent, per year, averaging over booms and slumps. And it is this rate of increase since 1800 or so which has led to the very high standard of life in Western Europe.

Each year the Western countries, the rich countries, get richer by 2 per cent., so in five years they get richer by 10 per cent., 10 per cent of $1,000 is $800, so in five years a rich country will add to its

Cont'd on page 10

NUCLEAR AGE 'RULER'. One of the most exact standards of length measurement yet devised by science is attainable with this lamp held by a U.S. Bureau of Standards scientist. It contains mercury isotope 198 (obtained by bombarding gold with neutrons), and the green light emitted from it, when held near a radio-frequency "exciter", is measurable to one part in 100 million. Measurements of this exactness naturally have little effect on day-to-day transactions, but are extremely important for the precise calculations of science and technology. One advantage of this new standard of measurement is that it can be applied almost anywhere with comparatively simple equipment.

USIS

THE GAP BETWEEN RICH AND POOR *(Cont'd)*

wealth $100, which is as much as anybody in the poorer countries has to live on. No wonder that the rich countries are getting richer very much faster than the poor countries are getting less poor.

Now, this widening gap is statistically true for a large part of the peoples of the world. Why is it true? Why isn't something done about it? This comes down to the question of the cost of development work and manufacture. Many of the poor countries know how to make things, but they cannot do so because they lack the skill in enough of their people, or the capital to put into the machines and the factories to make the goods. It is the extreme expense of starting off an industrialization process which is holding up the application of known science throughout the world.

It is very important to réalise that science, although it has achieved these marvellous things, is not a magic wand to wave over a poor country and make it into a rich one. Science text-books are cheap ; it is reasonably cheap to train scientists ; but it is extremely expensive to embody the science in the factories, the steel works, the transport systems, the power station, the mines and the chemical plants. They all cost an enormous amount of capital, and the poor countries are very hard put to find capital. And that simple economic reason is why science is so very unevenly applied over the world today.

★

I agree that the most important thing for mankind is not to blow itself up. But I am curiously an optimist about this matter. Some of my friends I call rational pessimists, and I call myself an irrational optimist. But I am an optimist. And assuming that we won't blow ourselves up, what is the next main problem?

I think the next main problem is to do something about the widening gap between the rich and the poor parts of the world, the rich countries which have successfully used science and obtained all the benefits, and the poor ones which have not. Now, if we don't do something about this widening gap, in a few decades, if the standard of life in the West goes up at the present rate, we may end up with a large part of the world poverty-stricken, as for centuries past, while the advanced countries of the West are enjoying (if "enjoying" is the right term) what has been called a "five-day week-end."

So great is the productive possibility of mankind that that is not an impossibility. Let me say quite definitely that all the evidence is that Western Europe has been the source of science for accidental social reasons and not because of any innate superiority whatever, and there is no reason why all the other nations of the world shall not be as good scientists and engineers as ourselves.

Professor Blackett was asked if he thought that aid for science in other countries should be given through the United Nations and its Specialized Agencies, or by existing national programmes of technical assistance.

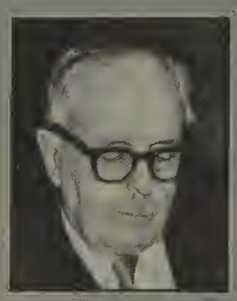
I think all methods have to be used. I think that as much aid as possible should be fed through the United Nations but, of course, there will be bilateral arrangements going on, and every sort of aid is needed. The total amount of aid is about one to two per cent of the national income of the West. That is only a fraction of what we are spending on armaments. If that was canalized into the under-developed countries, not as a charity but as a long period investment without political strings, it would enormously help them to get over the extremely difficult problem of the first years of industrialization.

B. A. HOUSSAY

PURE SCIENCE: THE ROOT OF HUMAN PROGRESS

It is a mistake to talk of pure and applied science. There are not two kinds of science but only one, and there are the applications of that science. The public in general and governments, too, think that only applied science is useful. They are very much mistaken. People should realize that all the knowledge on which applied science is based comes from theoretical or pure science. If theoretical or pure science is brought to a halt or loses its impetus, then application, too, becomes sluggish or stops. So we should make no distinction between these two aspects of science.

Industry draws off the best academic scientists and thus deprives research of their services. This is an unfortunate situation which society must counteract by enabling more scientists to devote themselves to research and to the training of new research workers. Pasteur said: it is not the long and involved political discussions we may read about in the newspapers that help mankind to progress, but only the great discoveries of science, of human thought, and the uses to which they are put.



D. BOVET

CONFLICT OVER APPLIED VERSUS PURE SCIENCE

We are witnessing a change in the personality of the scientist. He is now an essential element in society, for which he is becoming a source of wealth though also a potential source of danger.

While scientific research has become one of the primary concerns of governments, their support is, unhappily, most often given to research applicable to the waging of war. We are here to plead the cause of pure research, disinterested research, research for peace.

Research, alas, has become an asset to be administered, used for gain and closely controlled. Governments are strong to the extent that their research yields results of economic value. The modern world is assimilating research in the same way as it is using oil and coal.

While recognizing the fact that science enjoys certain material benefits, we cannot help being alarmed by some aspects of the problem; that is why we scientists feel ourselves to be responsible and are here to examine our consciences.

We must see to it that university teaching is not impoverished; that humanistic teaching is not impoverished. We must see to it that, where science is concerned, authority is not transferred from the university to politics. We must do everything to avoid the militarization of our endeavours and our culture.

The question of the degree of responsibility of the scientist, and particularly the physicist, for all our weapons, all our wars, has sometimes been raised. Let me take up his defence—a task which is easier for me as I am not a physicist.

Science is innocent of the crimes of which it is accused. The only guilty party is society—a society insufficiently permeated with the scientific spirit.

NO PLACE FOR GERMS

Bottling of penicillin and other anti-biotics demands precision and stringently sterile conditions. In this French anti-biotics manufacturing plant (left) elaborate precautions are taken to ensure this. Air entering the workplace is put through a conditioning plant, then filtered and sterilized and is finally given a pressure slightly higher than the outside air to prevent any non-sterilized air from infiltrating. Workers, wearing masks and sterilized clothing, must enter through a special room in which they go under the germ-killing rays of ultra-violet lamps. Machine shown here fills and seals 2,000 bottles an hour. Woman on right feeds it with empty bottles while the one on the left collects bottles at the end of the operation. Three other women workers, not seen here, keep the machine supplied with anti-biotics, stoppers and capsules.

© Laboratoires Roger Bellon, Neuilly-sur-Seine

TAKING NO CHANCES

Slip-on protectors are worn over shoes by U.S. atomic plant workers as a precautionary measure against the possibility of walking on floors that may have been contaminated by radiation. Measures of this kind help to explain why the U.S. atomic industry's safety record is three times as good as the average safety record for all industries in that country. Wherever nuclear energy is used for any purpose there is a rigid enforcement of safety standards.

USIS

G. BERGER

REDUCING ARMAMENTS BY 1% MEANS $1,500,000,000 SAVED FOR USEFUL, CONSTRUCTIVE WORK

TODAY we hear a great deal of talk about society, and society of course merits this attention. Some societies are prosperous, others are underdeveloped, but in every case it is man and man alone who experiences the suffering, grief, anxiety and despair, and whenever we forget man, then civilization is in peril.

The sciences of man are complex and difficult—more difficult than all the rest. But they are no less necessary for that. We are all agreed that war does nothing to solve our problems, that it is the worst of all evils; yet nations continue to prepare for war. To take a less obvious but no less telling example, it is very obvious that increased agricultural output calls for some mechanization and proper ways of fertilizing the soil. But the peasant has to be persuaded to give up his usual habits and to use fertilizer in the right way and in the right place. In other words, the problems besetting the world today are first and foremost human problems.

If we are unhappy or anxious, it is not only because we have not enough power or raw materials or machinery, but because we do not know how to set about working one *with* another instead of preparing to fight one *against* another.

It takes more than conviction, enthusiasm and sincerity to put over a point of view to other people, to convince them and arouse their enthusiasm. A certain technique is needed, too. Social and psychological techniques exist, but I am afraid that these techniques have not yet been given all the attention they deserve from those responsible for the allocation of funds.

There is one kind of research for which everyone is willing to give money—applied research which produces immediate results. "We want such and such a thing; make it for us straight away!"—and money flows freely. But basic research rouses far less enthusiasm. To some it is a kind of luxury. Yet I feel that one of the very real benefits of this Round Table has been to prove that the basic sciences are as useful as and perhaps even more indispensable than any other kinds of science, and that they deserve the fullest official support.

The sciences of man, however seem useless and they are systematically neglected. Yet these sciences offer the surest means of solving the world's problems today—and the proof of their potency lies in the very fact that they can do harm.

A science reveals its real power when people doubt that it is capable of doing good and point out that it actually does harm. We have heard about the dangers of psychological warfare, and we are all aware of the dreadful insidious influence of propaganda. Propaganda has a power to influence our deepest thoughts and feelings, and instead of compelling us, by overt, external force, to do things we do not wish to do, it makes us condone and acquiesce in injustice, crime and the vilest of acts!

If psychological techniques can thus corrupt men's minds through propaganda—which is the great danger threatening us—then it follows that psychological and social techniques may also be an effective antidote to the poison of propaganda.

People sometimes say—though it seems to me ridiculous—that the machine age threatens mankind, and that soon we shall resemble the robots depicted in certain films of the past, spending our lives mechanically pressing buttons. That is not the kind of future that awaits us. We are not in danger of being enslaved by the machine but by our fellow men. It is society, equipped with every instrument of propaganda, which will instil into our minds the subtle, imperceptible poison that will make us bring about our own downfall.

Science is a search for light and truth. We must see things as they are and develop our sciences of man openly, fully aware of our acts, knowing the dangers they may hold, but at the same time conscious that, like other branches of science, they offer great possibilities. We should realize that the sciences of man must not be set up in opposition to the other sciences—that would be ridiculous—but must be used with them in an attempt to bring men greater happiness, a little more wisdom and perhaps the kind of life that we all dream of—a life giving us a true feeling of the dignity of man.

★

SCIENCE and culture are not foes but friends, helping and strengthening each other. It is a mistake to suppose that we have to choose between technology and culture, as if culture were not based on precise technical knowledge and vice versa.

We have the technical facilities for spreading culture, just as we also have the technical means of fertilizing the soil, feeding mankind and, perhaps, of transforming the world.

We have the money to do this, far more, in fact, than we need. Each year, the expenditure on armaments of the member countries of the United Nations adds up to more than one hundred and fifty thousand million dollars. If 1% of this vast sum were set aside for science, education and culture, and for feeding mankind, we should have at least $1,500,000,000 available each year for this peaceful, constructive work.

I know the serious domestic difficulties that arise over the transfer of a percentage of any country's military budget to its education budget. But such difficulties are removed when the same effort is made by all countries and the *relative* expenditure on armaments remains the same for all.

No doubt the day will come when countries will no longer spend money on arms. But we cannot afford to wait until governments learn wisdom and peoples develop confidence in each other. Something can be done—and done now.

I think we might very well consider a line of action which combines great symbolic significance with real practical value. This idea, which has been put forward by others before me, is that all the governments should make a 1% cut in their military budgets and use this money for the development of education, science and culture and for improving general standards of living.

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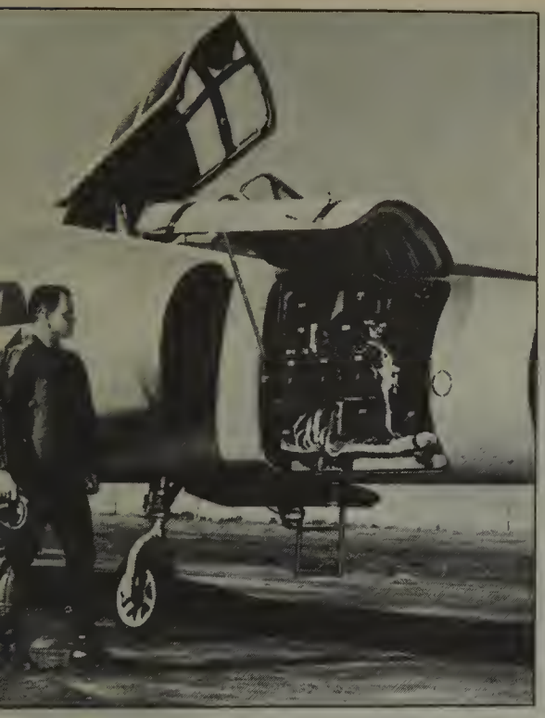
SCIENCE is useful, and it has been clearly shown that pure science is as useful as what is called applied science. It is necessary for the laboratories to work in close touch with industry, but it is equally necessary for scientists to have good working conditions, and one more essential thing—enough time for their work.

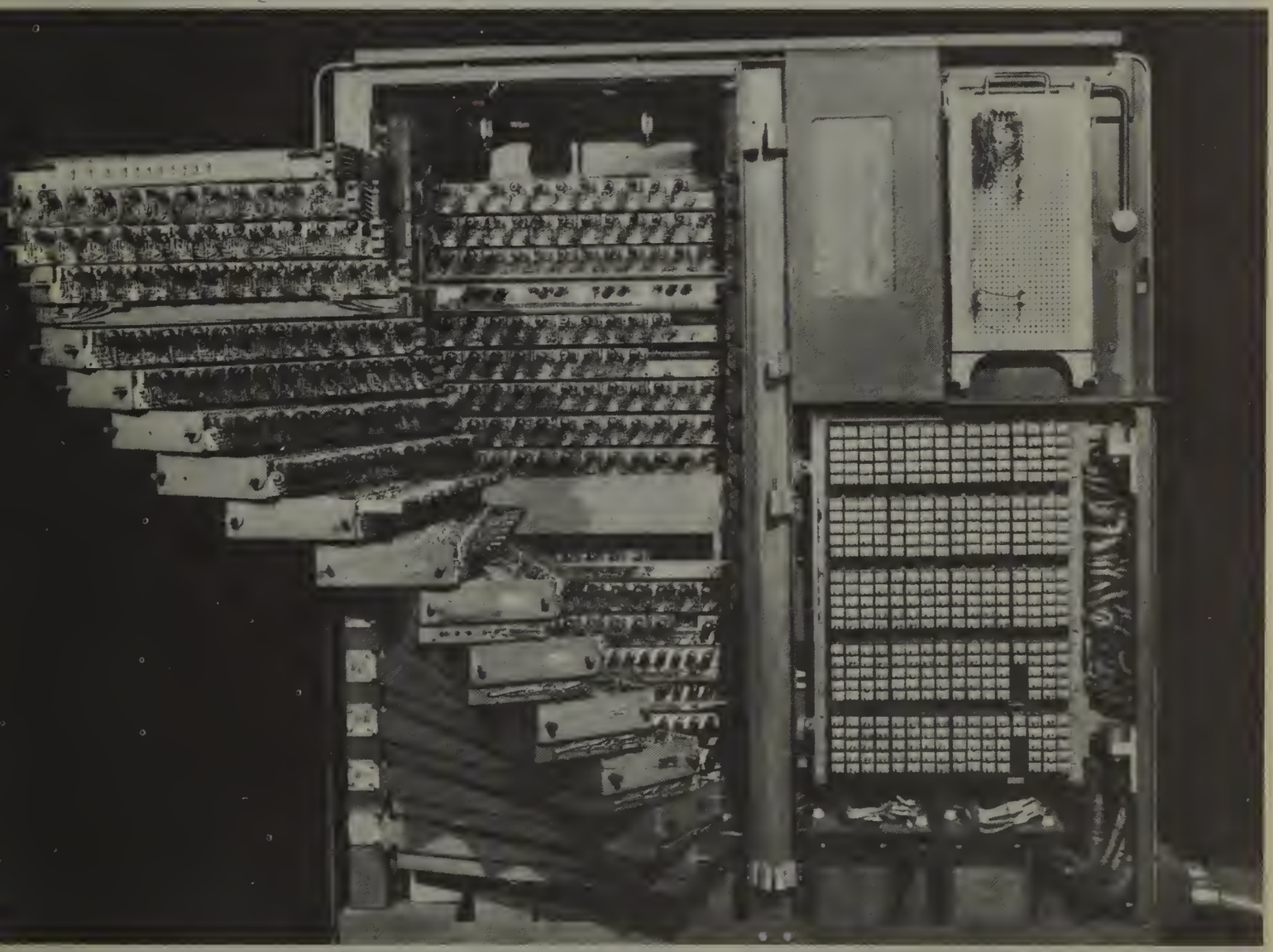
One of the greatest difficulties we have to face in these days when everything is moving so fast is that we no longer have time. A scientist must have leisure. Discoveries do not come to order. They come from the work of suitable research teams provided with proper equipment. For I speak from experience when I say that what tempts academic staff most in the offers made to them by industry are not high salaries but the working facilities they are given. If we want to keep scientists in our laboratories, if we want men for basic research, we must equip those laboratories. For scientists, that is more important than material gain.



FLYING 'BRAIN': 6,500 DECISIONS PER MINUTE

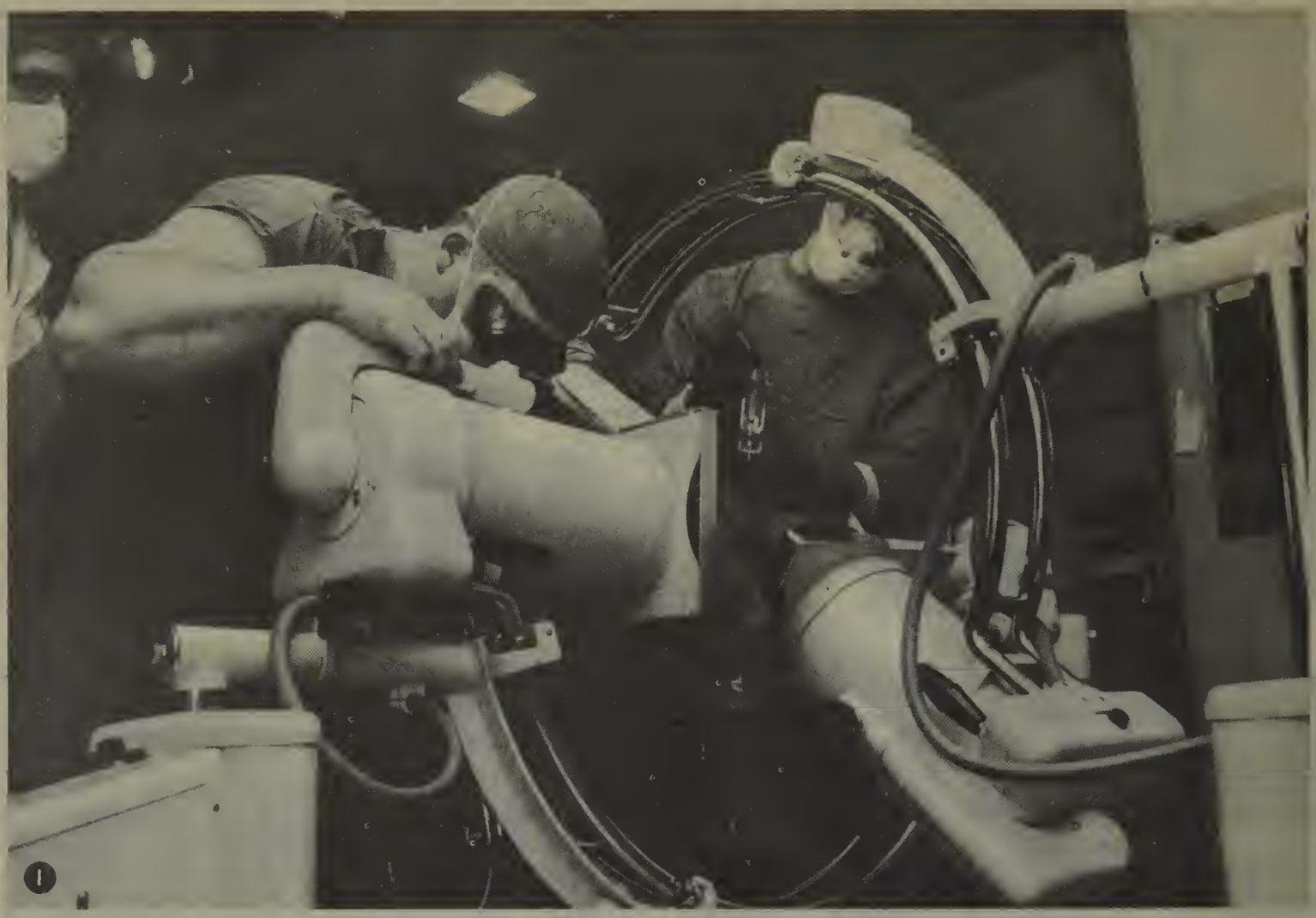
Science and technology are today liberating man from drab repetitive "thought". Today, one man at the controls of a giant calculator can have at his command the computing ability of 25,000 trained mathematicians. At the other end of the scale, " miniature " calculators are being developed to take decisions for pilots flying above the speed of sound. Small "brain" (right), which can produce 6,500 decisions per minute is now used in U.S. jet plane (left).

USIS



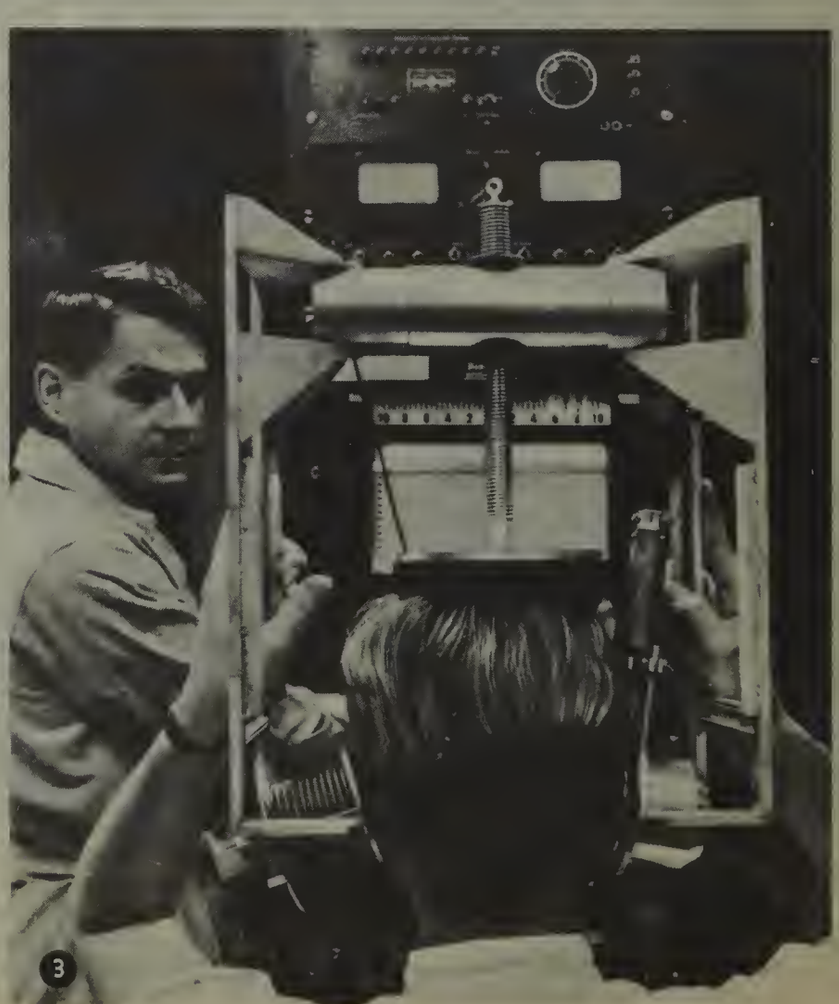
© Compagnie des Machines Bull

GAMMA CALCULATOR, the first of its type to be designed and built in France, can add and subtract figures of 12 digits in 0.17 thousandths of a second and gives the answer to a multiplication of eleven digits by twelve digits in twenty-one thousandths of a second. The machine not only prints the answers to the problems posed to it, but stores them in a "memory". Business men already envision a day when electronic brains will be used not only for paper work problems, but to operate factories, to run automobile production lines or any plant where the process can be reduced to a pre-set repetitive system.

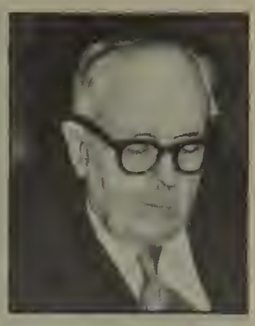


(1) Atomic energy has proved to be an amazing tool for medical research, diagnosis and treatment. In the U.S.A. alone more than 2,000 hospitals and physicians use radiation for the benefit of more than one million patients per year. Here, a U.S. surgeon (on right) implants radio-active pellets of yttrium-90 in the pituitary gland of a cancer patient—a method used to destroy those cancers susceptible to hormonal alteration. Assistant (left) watches an amplified image of the patient's skull on a TV screen and guides the operation, which is performed quickly and only requires the use of a local anaesthetic. (2) New equipment for treating brain tumours being demonstrated at the Massachusetts Institute of Technology. In an adjustable bed the patient can be raised to the desired position directly under the ceiling vent ready for release of the beam from the Institute's new reactor. (3) People who are hard of hearing can thank this strange looking headgear and the scientists who invented it for constant improvements being made in hearing aids. It enables scientists to make a rapid check on the efficiency of different types of earphones. (4) Doctor at the Moncorvo Filho Hospital, Rio de Janeiro, uses a scintillation probe to measure the amount of radio-active iodine which has been secreted in a young boy's thyroid gland, following an injection of this radio-active isotope. Using the probe, the doctor can determine how well the gland is functioning.

1, 2, 3) USIS. — 4) UNITED NATIONS.



THE MEDICAL REVOLUTION IN THE FIELD OF NUTRITION



B. HOUSSAY

MEDICINE was really born with the first man. Since then it has passed through widely divergent stages. From being the prerogative of priests and magicians it became empirical and finally scientific. In the early stages, priests or wise men tried, by exorcism, to drive out evil spirits or to invoke the beneficent intervention of the gods. Later, as men found that observation yielded better practical results, empirical medicine came into being. A body of scientific data was slowly amassed down the years and in the 19th century, following the great advances made in the natural sciences—biology, chemistry and physics—medicine adopted the scientific method and, above all, the method of experiment.

It was the experimental method which brought about such far-reaching changes in medical science. The discovery, for instance, that some diseases were caused by microbes made it possible to take precautions against and to combat several kinds of infections, and also to ward off or to arrest the course of the great pestilential epidemics which used to take such a heavy toll of human life.

In our own time another great revolution has taken place—in the field of nutrition. Although it is perhaps not yet understood by the general public, this is perhaps the most important. We now know man's needs for proper nourishment through the discovery of vitamins and our understanding of the role of proteins and minerals in human diet. This has been responsible for a tremendous improvement in human health.

Even a few facts show this trend. Infant mortality was once extremely high; one child in three died before its third birthday; nowadays, in countries with high living standards infant mortality has dropped to one out of 15 or even 20. In many countries at the beginning of this century, average life expectation was 40 years; today it is now anything up to 70.

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LONGER life and a lower death rate have had many other effects. The increased number of old people has made it necessary to give attention to gerontology which concerns the medical care and health problems of the aged. Infectious diseases have undoubtedly been fought and conquered, but as the average expectation of life increased, man was found to be suffering from different ailments. The arteries, the joints and the heart were affected by age, and this made new research necessary.

Other diseases have abruptly increased, among them cancer. This can be treated to some extent, although the real goal should be to attack the disease in all its forms.

The discovery of hormones, which play such a great part in therapeutic medicine, deserves mention as does the discovery of insulin. What used to be pernicious anaemia no longer merits the use of the adjective pernicious; people who would once have died of it can now be cured.

In recent years, much important research has been done on nucleic acids. You can prepare nucleic acid and store it in a jar; then one day a few drops of this preparation given to a plant will cause the plant to catch a disease which can be transmitted to others; this crystal therefore propagates a disease, as with a living being. Even more strange is the fact that it has been possible to modify the chemical molecule of these nucleic acids and thus produce mutations. Thus, diseases can also be changed in form.

One of the great biochemists working in the U.S.A. has found a way of synthesizing enzymes, which in turn can synthesize nucleic acids. The way is thus open to the production of many things—viruses, genes and so on. A whole new world is opening up before us.

Patient suffering from a deep-seated malignant tumor is prepared for treatment at the Institute of Scientific Research for Radiology in Moscow. Specially designed for tumor treatment, the X-ray machine (below) directs its rays with a high precision on the tumor thus sparing healthy tissues surrounding it. The patient is subjected to the rays from two X-ray tubes which rotate continuously around him, working automatically to a pre-set pattern. Photo, right, shows a patient at the Royal Marsden Hospital, England, receiving treatment for cancer from radio-active caesium which is placed in a rotating treatment head (centre, above patient). In background is a small television camera which enables the radiographer to watch the patient from her control room (photo, bottom right) without coming into contact with the gamma rays emitted by the caesium. The patient can speak to the operator through an amplifier.

1 - Official Soviet Photo 2 - 3 - Photos Royal Marsden Hospital, England

Official Soviet photo

Ultrasonics—the study and use of high-frequency, inaudible sound waves—has found countless applications in research, medicine and industry—from industrial drilling and the removal of barnacles from ships' hulls to the aging of whisky. Here two glass objects—a jar and a valve—have been pierced by ultrasonic vibrations. Razor blade and pocket knife simply mark the holes.

W. NOYES

HAVE WE THE RIGHT TO USE UP OUR SOIL RECKLESSLY?

Raw materials are not distributed evenly over the surface of the globe and some of them are being used up very rapidly. In the United States of America, iron ore—or at least the best quality iron ore—is beginning to run out. Some important elements, such as copper, for instance, are no longer to be found, and now have to be imported. Similarly, there is not an inexhaustible supply of coal and fuel oil.

It is, of course, the industrialized countries which are such heavy consumers of all these raw materials. These countries have therefore had to look for raw materials wherever they happen to be available, and this raises not only a practical but also a moral question.

Have Americans or Europeans, the right to use raw materials coming from a country which may not be industrialized just now but which will perhaps be industrialized in 50 years' time and will then need these raw materials for its own development?

I do not pretend to be able to solve this problem, but am merely putting it to you as an issue that will be important in the future.

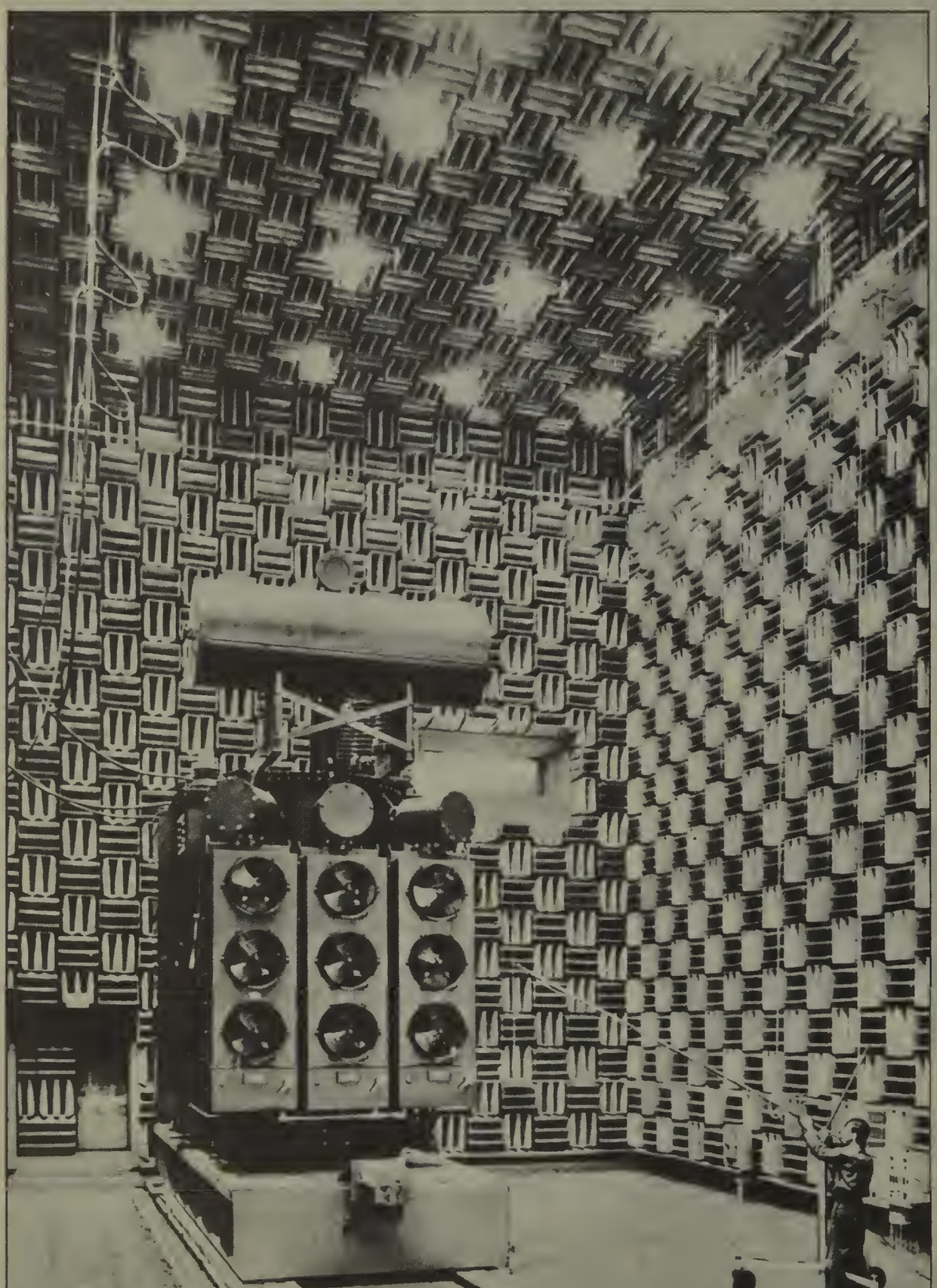
Let us look at the matter from a slightly different angle. We export foodstuffs from the United States; the same is true of South America and many other countries. Have we the right to use our soil recklessly and let it wash away into the Mississippi, for instance? Have we the right to let it become exhausted, with the prospect of not being able to use it for growing food in another fifty years? By doing so, may we not run the risk of leaving the people of other countries to starve to death?

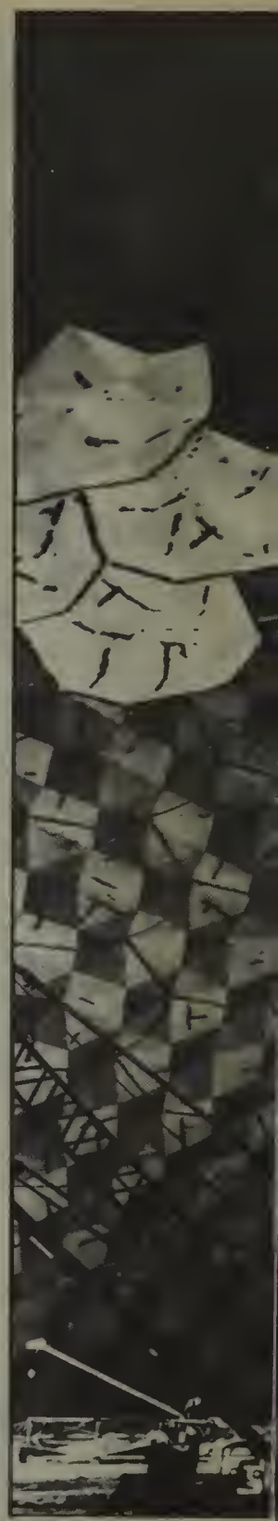
I do not mean that you should make war on us because we are misusing our soil, but I would emphasize that this is a matter on which you should reflect. Have Americans the right to do exactly what they like with their country?

I am quite aware that this view is not very popular in the United States but I for my part would like to stress these facts because of their moral aspect and, above all, because they bring us face to face with one of the causes of wars.

Everyone ought to think seriously not only about the way existing raw materials are used, but also about the means of preserving them for future generations.

TECHNOLOGY'S HAND IN OUR CHANGING LANDSCAPE





A technical revolution is
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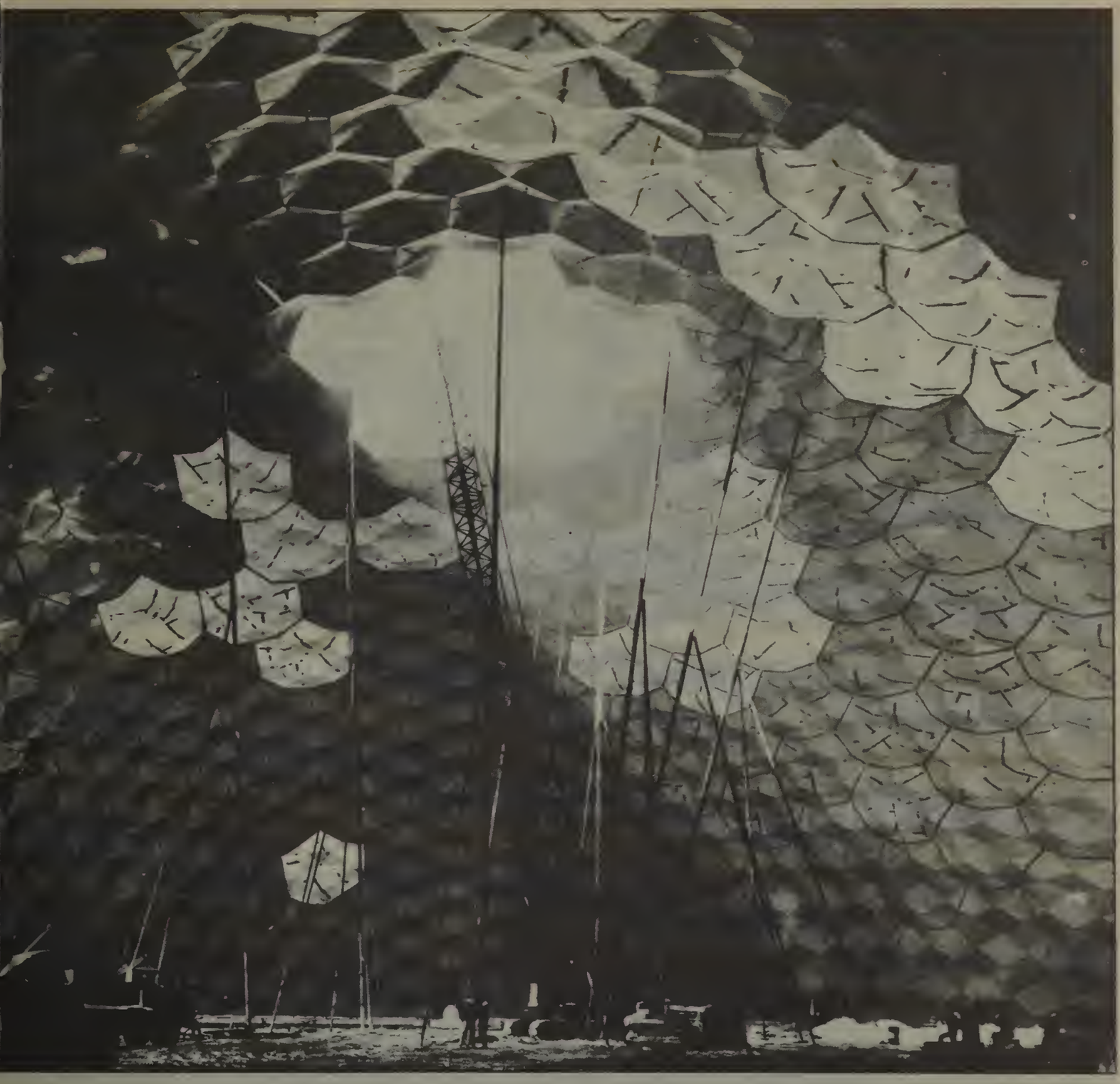

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of producing and fabricating such common metals
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ne U.S.A., will be a railroad tank car repair and
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this time of aluminum panels, also in the U.S.A.
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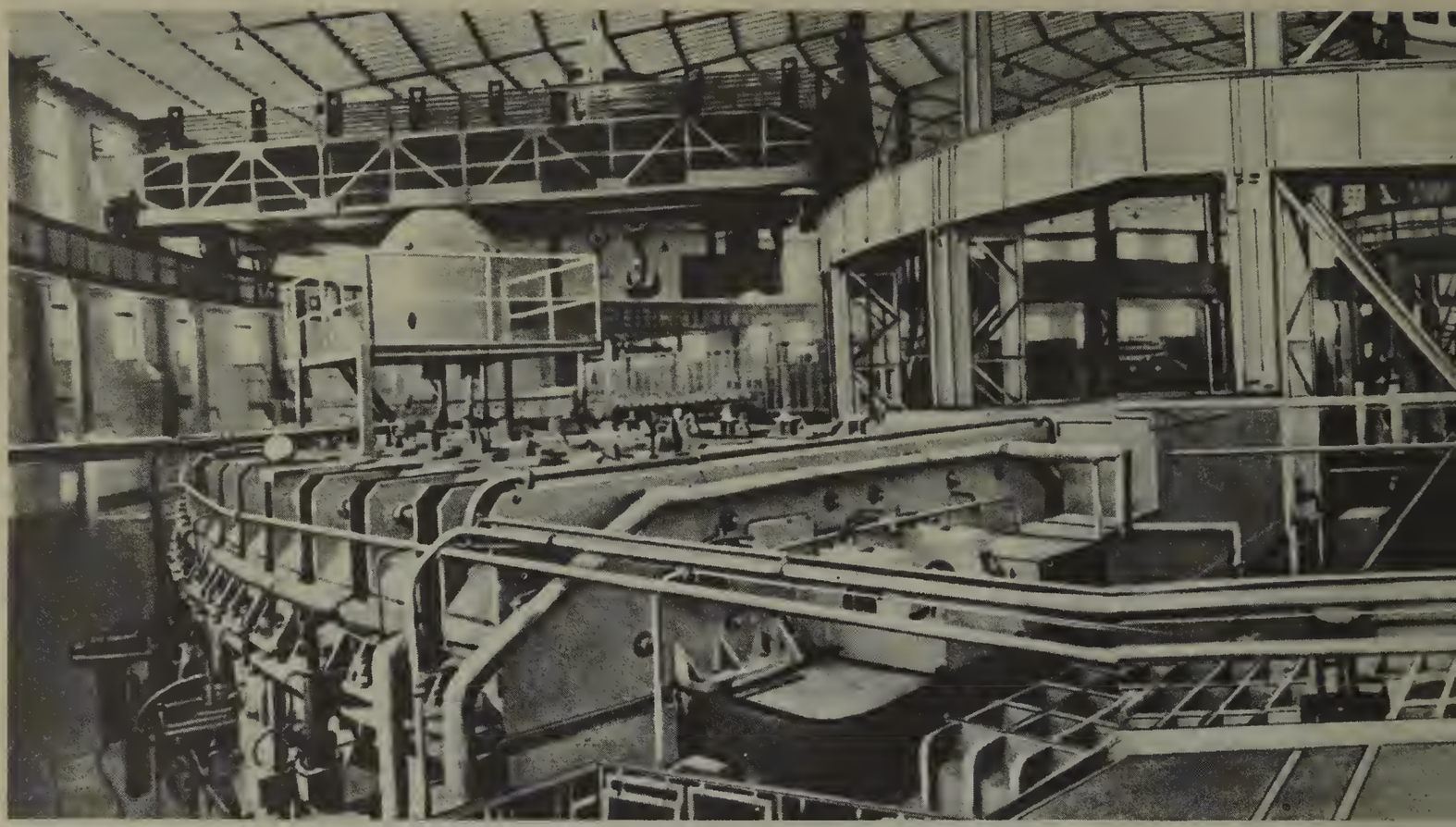
—the less noise, the greater efficiency. Walls
e up of concrete, galvanized sheet, and fibreglass.

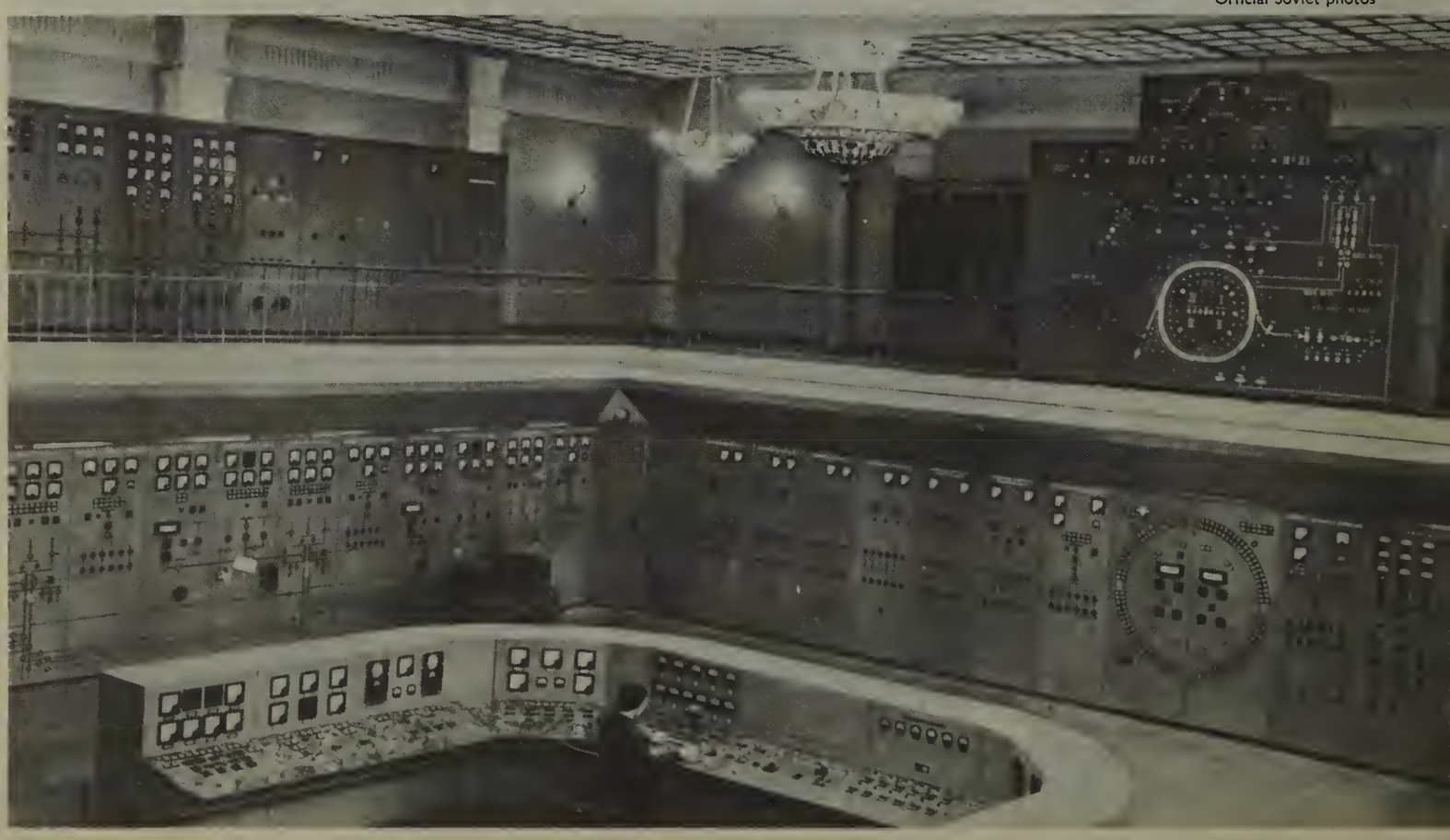
USIS

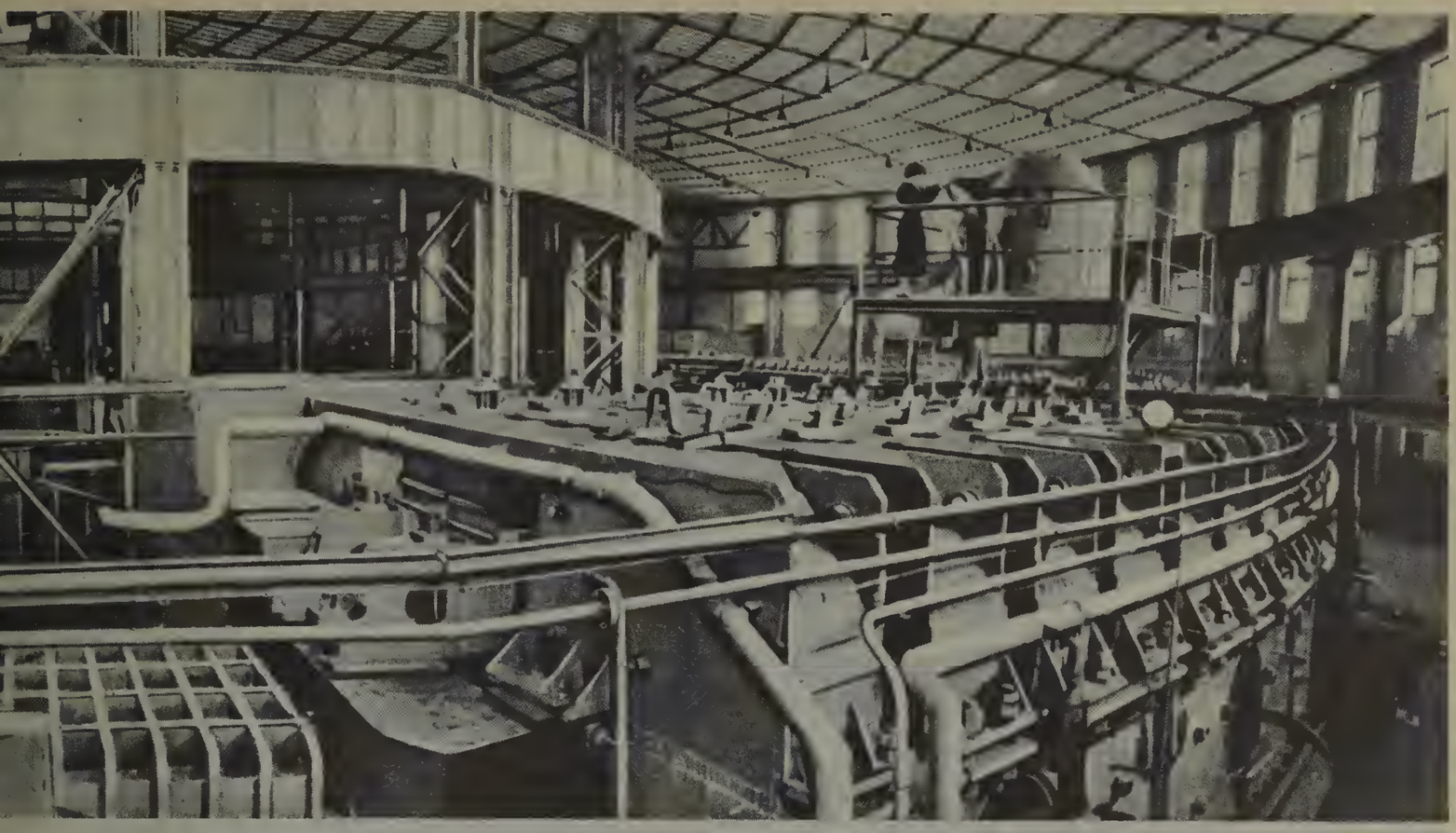


TEN THOUSAND MILLION ELECTRON-VOLTS FROM DUBNA'S GIANT ACCELERATOR

Atoms for peace have already found a thousand and one uses. The basis for future developments, however will continue to be laid in research and experimental laboratories where scientists delve with mighty machines into the still mysterious world within the atom. The most impressive of these machines are giant particle accelerators, like the huge ring type accelerator in the High Energies Laboratory of the Joint Institute for Nuclear Research at Dubna, near Moscow, shown on these pages. Known as a synchrophasotron, this machine can accelerate protons to reach an energy of 10,000 million electron-volts. Its electro-magnet (seen in photo, above) has a diameter of over 180 feet and weighs 36,000 tons. Below, the main control room of the synchrophasotron. Another accelerator at Dubna, a synchrocyclotron, can create energies of up to 680 million electron-volts.

Official Soviet photos





N. SEMENOV

PEACE OR WAR:
WHICH ROAD WILL HUMANITY TAKE?

WHAT is the situation facing us today? Science has the means to bring happiness and contentment to the world and collective efforts can lay the foundation of a truly great future. But should a new war break out (it would inevitably be an atomic one) then mankind would experience the most dreadful fate it has ever known.

Which road will humanity take? The decision rests with us, on our goodwill, our efforts and our determination. What we can and must do is to put an end, once and for all, to the testing of nuclear weapons. Though this is perhaps not the main problem it is of primary importance, for the first effect of prohibiting nuclear tests would be to prevent any further improvement of devastating nuclear weapons. It would put a stop to radiation contamination and would help to re-establish international confidence.

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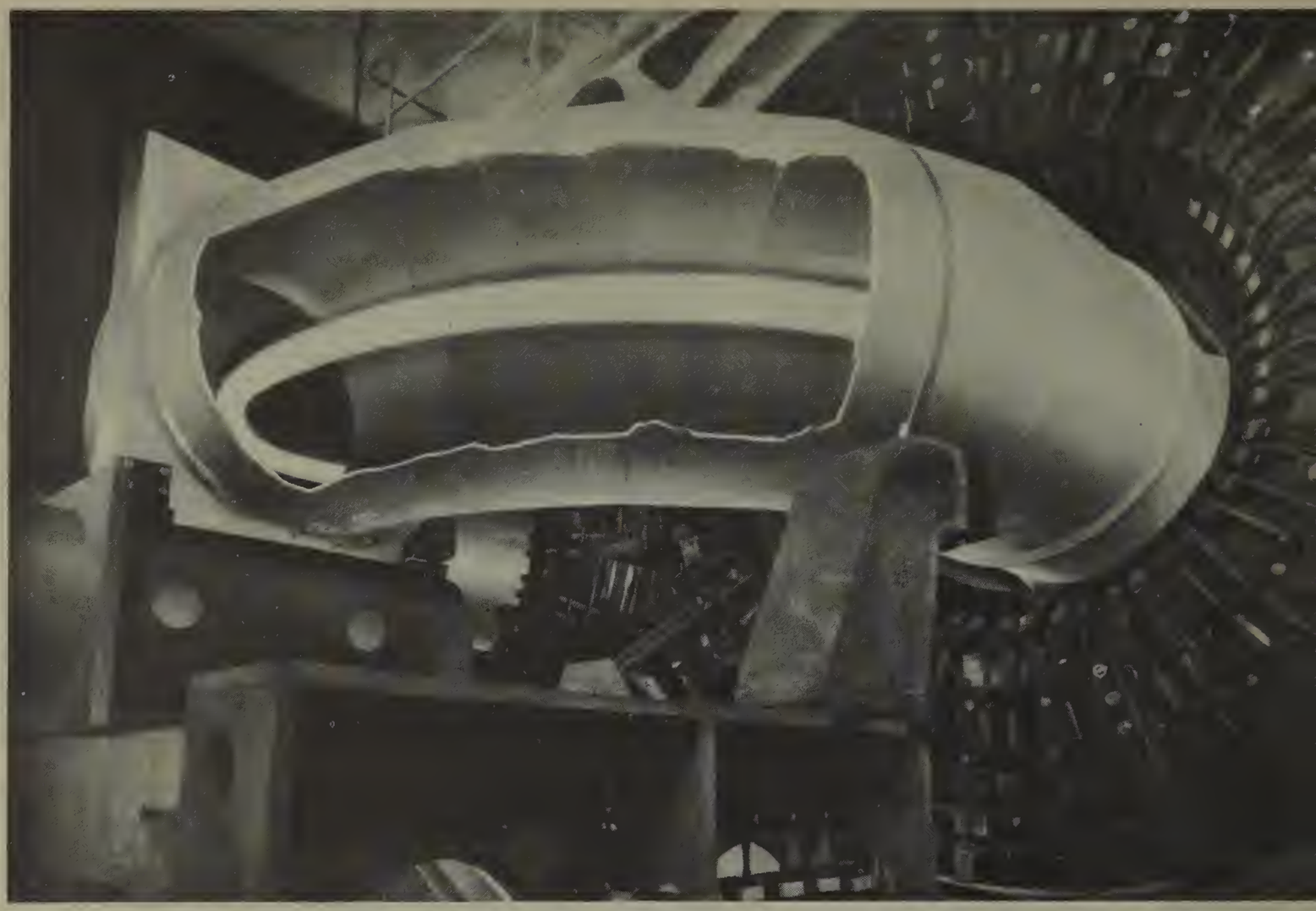
THIS would do much to dispel the present worldwide fears and depression caused by the "cold war". Finally, and most important of all, it would hasten the next and most decisive action—a banning of the production and use of nuclear weapons, the destruction of all existing stocks of such weapons, general disarmament, and the renunciation of war as a means of settling international disputes.

War is a relic from the past, a terrible and barbarous survival which should have no place in a civilized world. The menace of war has a disastrous psychological effect on people and entails the squandering of a vast amount of labour and resources; an enormous number of men do nothing but learn how to kill one another. The overall effect is to prevent nations from concentrating their efforts and using their resources to improve living standards, to enrich their cultural life and to assist economically under-developed countries; it prevents them from feeding and clothing their people properly and hinders normal technological development.

The most important task today is to end this nightmare. A unanimous and active world opinion could have a decisive effect in settling these questions, leaving aside other relatively secondary problems not directly related to them.

In this collective effort to safeguard international peace, to ban the testing of nuclear weapons and these weapons themselves and to abolish war, the scientists, in all countries, who are sincerely concerned for man's future and for the progress and integrity of science, must unite and take a leading part.

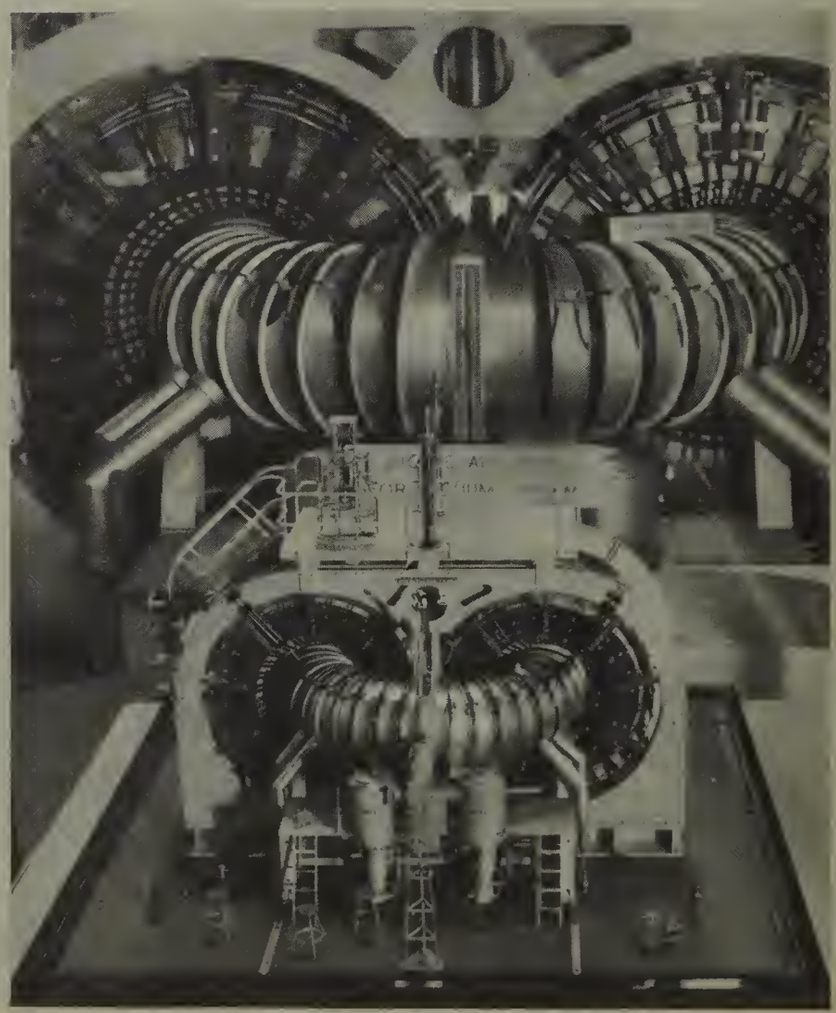
I am convinced that the vast majority of true scientists do not work simply for the money they earn. Thus they cannot stand idly by while science is destroyed and the prospects which are opening up for it are brought to nothing. It is a great blow for us to see the results of our scientific work used to the detriment of mankind, and in the present case we cannot tolerate it. We scientists must not stifle our humanitarian feelings but on the contrary, give them full freedom, as should every honest person. We should be keenly aware of our responsibilities, and then act accordingly, uniting our efforts to solve these problems. All of us living in the 20th century, whether scientists or not, have a great obligation, not only to ourselves but to future generations. If we succeed in dispelling the heavy threat of war and concentrating our efforts on opening up a new and enlightened era, mankind can look forward to a truly happy existence even during our own century.



Photos © United Kingdom Atomic Energy Authority

MORE HEAT THAN IN THE HEART OF THE SUN

Among the most exciting of all atomic energy projects is the possibility of creating energy by the fusion (or joining) of light atoms such as those of hydrogen. (Most nuclear reactors are based on the fission—or splitting—of heavy atoms like those of uranium.) The fusion process has been studied for some years past at Harwell, Great Britain, with the aid of an apparatus called ZETA (Zero Energy Thermonuclear Assembly). Photo right, shows model of ZETA at the Science Museum, London. In this apparatus, pulsed electrical currents are passed through heavy hydrogen gas held in a "doughnut" shaped tube. Magnetic forces generated by the high current and those of external coils have held the hot gas discharge clear of the metal tube walls long enough to enable nuclear reactions to take place. (In diagram, above, white strip represents hot gas pinched by current.) So far it has been possible to maintain hot gas at temperatures of up to five million degrees Centigrade for about three-thousandths of a second. With extra equipment it is hoped to produce temperatures of up to 25 million degrees—far greater than the central temperature of the sun (15 million degrees Centigrade). But temperatures exceeding 50 million degrees must be achieved before a thermonuclear power station can be seriously considered. Another record breaker, this time in supersonic flight, is the Faire Delta II (opposite page), a prototype British jet aircraft which has been used for research into the multifold problems of high-speed flight.



As H-Bombs mean mass suicide

WAR IS NOW OBSOLETTE

H. J. BHABHA

WAR is the greatest waster of raw material that we have. In many industrialized countries 1/3rd of the entire national expenditure goes into producing instruments of war, which we hope will never be used. We all know that atomic and hydrogen weapons are very destructive, but I doubt if the ordinary citizen fully realizes how destructive they are.

One has only to remember the bomb-damage, the destruction in France, the devastation of Germany and the Soviet Union—most of this destruction was caused by conventional explosives. And the total amount of explosives used by both sides together in the last war amounted to between two and three million tons of TNT.

Now, one hydrogen bomb can have several times this explosive power. It is of importance to realize in concrete terms what this explosive force means. The area of total destruction for a multi-megaton weapon, say a 15 megaton bomb is 5 miles or about 8 kms. An expert has said that buildings in this area would be fractionalized, pulverized and vaporized. Irreparable damage would be caused to houses within a radius of some 12 kms.

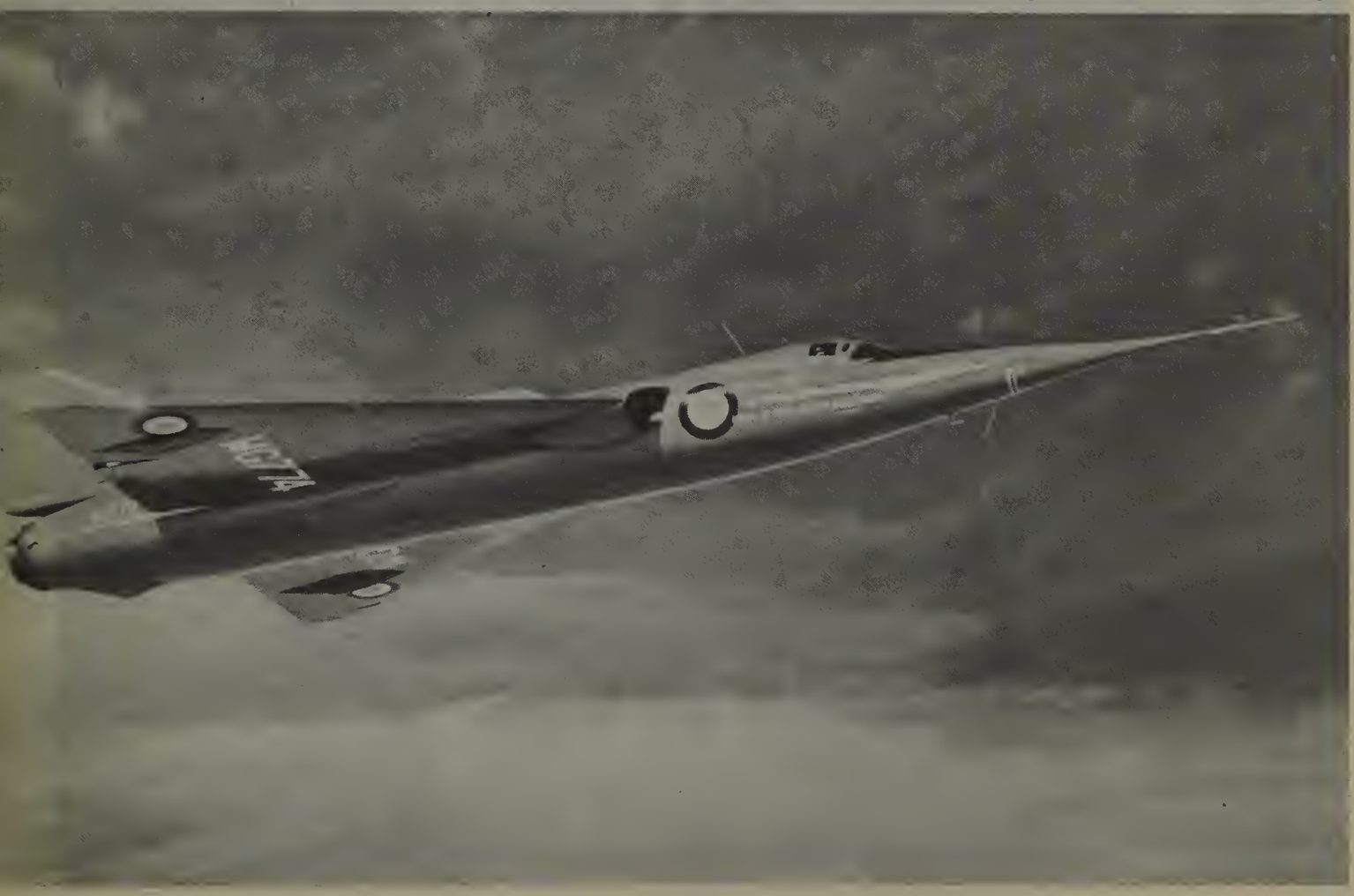
In addition, there is the radiation effect and the fall-out. Depending on the direction and the velocity of the wind, 50% of the population would receive a lethal dose in a strip 40 kms. wide and about 300 kms. long. Draw this on a map of France and you will see how large it is.

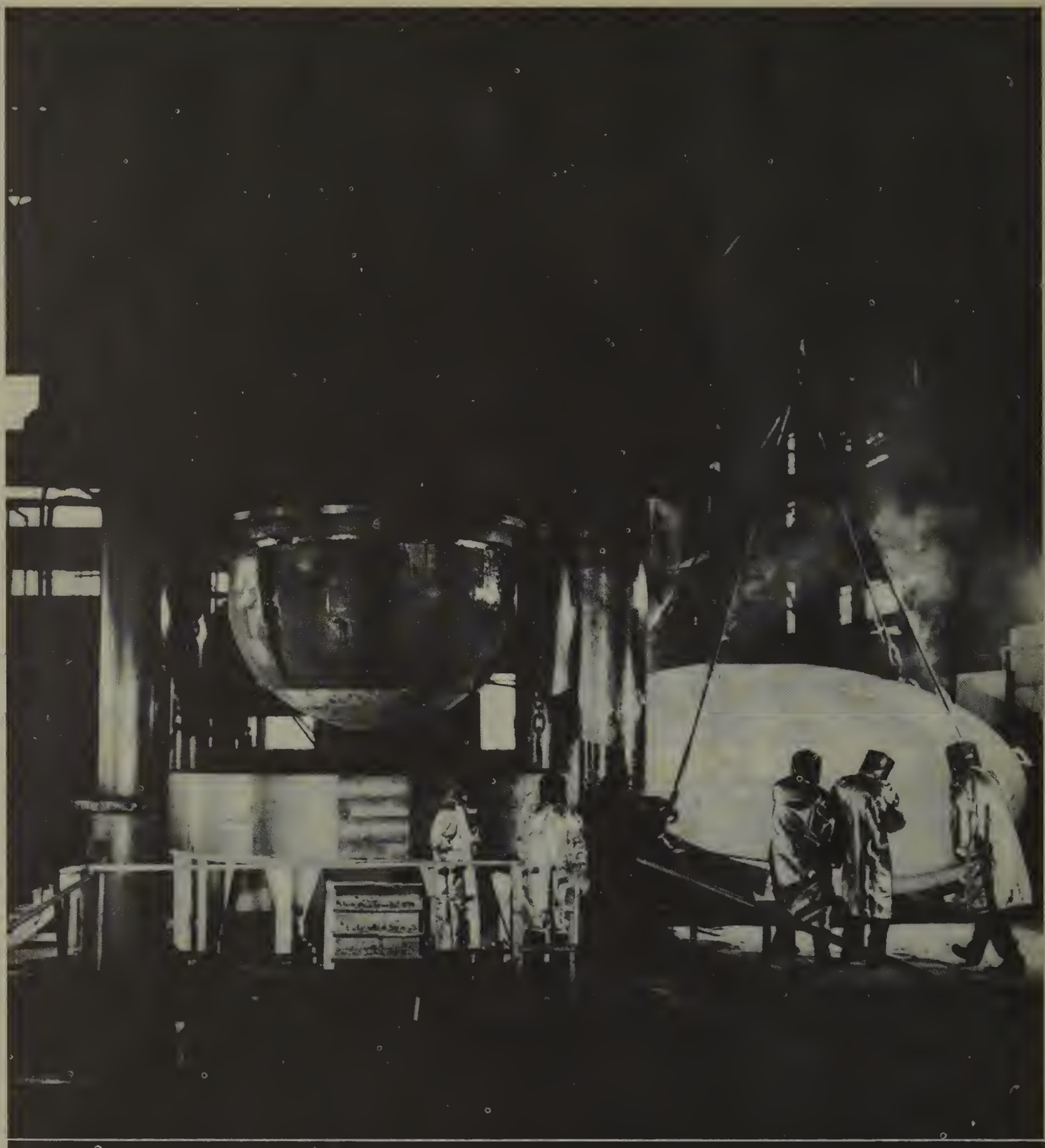
I fervently hope that such a weapon will never be used. It is the responsibility of every one of you to see that it is never used. This matter is one where the ordinary citizen has to express himself. It is now clear that with these weapons a total war is not feasible any more. It would amount to mass suicide or mass murder.

But there is a more insidious danger which I would like to point out and that danger is the so-called small tactical atomic weapon. Today such a weapon is of a size comparable with the Hiroshima bomb. It may be a quarter the size, but it is several hundred times bigger than the largest block-buster of the last war. Such a weapon must be a fission weapon and cannot be clean. By its very nature a considerable area of the ground would be contaminated with the radio-active fall-out. To talk of such weapons as "small, tactical weapons" is to deceive the public. And it is this which has such serious consequences.

Now, it is a matter of some disagreement among experts and specialists of atomic weapons and military experts whether small, tactical weapons could be used in a limited war without leading to the use of larger weapons. As long as there is this doubt, the use must be a gamble —a gamble with the future of civilization and the future of humanity itself. Would any responsible person agree to permit such a gamble? It seems clear to me that the progress of science and technology has made major wars impossible and, indeed, wars in effect impossible and we are only slow in adjusting our minds to the changed situation. But it is essentially the duty of every citizen to think about this matter and to express himself forcibly. This matter is too important to be left to the politicians and the military experts.

© Charles E. Brown, Worcester Park, England





USIS

The construction of nuclear reactors and atomic power stations has made new demands on industry and on the materials it uses. Above, steel workers in special protective clothing are subjected to intense heat as a carbon steel disk, 15 feet in diameter, is formed into the head of a vessel in which a pressurized water reactor will be installed. This reactor will provide heat for the production of 275,000 kilowatts of electricity at an atomic power plant near New York. Photos, opposite page, show two aspects of the main French Atomic Energy Centre at Marcoule. Left, fuel for an atomic reactor—uranium rods suspended in readiness for lowering into the reactor. Right, special metal construction is embodied in the pre-stressed concrete of the reactor shield. The concrete cylinder in which the fuel of the moderator will be contained is circled by steel cables exerting a pressure superior to that of the gas which is generated in the cylinder.

Photos Jean Pierre Sudre, French Commissariat of Atomic Energy

THE CAUSES OF WAR: FEAR, PRIDE, POVERTY

G. BERGER

FUNDAMENTALY I think there are three main causes of war. Firstly I think that war is brought about by pride, the pride either of those who feel they are minor powers and want to increase their importance, or of those who already consider themselves powerful, but who wish to extend their power.

The second cause of war is fear. Fear is always a bad counsellor. Fear sets little dogs barking and snapping and makes them the most dangerous. Fear has been the cause of many a war. One of the best antidotes to fear is knowledge which brings understanding and a clear view of things.

The third cause is want. I think it takes third place because poverty sometimes weighs down so heavily on men that they lose all hope and with it the spirit of revolt. Here science can help us. With its aid and that of the techniques it has made possible we can vanquish want.

Science can also help to cast out fear; this task is largely one of providing proper information and using common sense.

Pride is perhaps a more difficult nut to crack. The urge for power is implanted in the hearts of individuals and of nations alike and it can take a thousand devious, insidious forms. Here perhaps something more than science is needed. We must turn to ethics and to the techniques of the sciences of man. These sciences I take to include the techniques of social psychology and the study of man in a form which, though less mathematical, is no less exacting and precise. The sciences of man can show up the futility of pride and deflate the ego. We can never do too much in this direction.

Problems must be taken seriously, but we must never take ourselves too seriously. Here again there is a great deal of education to be done on these lines; nations and individuals alike have to be educated, and science, in the broadest meaning of the term, can help to banish the risk of war.

When want has become a thing of the past, when fear no longer grips men's hearts and when pride has been shown up as something ridiculous, then science will have done its work and true peace will be established among men.

THE ASTOUNDING CASE OF THE 'SNOW WHITE' DUCKS

Can science artificially modify or influence certain hereditary characteristics of creatures on the higher levels of animal life? Until a few years ago the answer given by biologists was a firm No! Experiments had however shown that it was possible to obtain mutations among bacteria by the use of desoxyribonucleic acid... more simply known by the initials DNA. Then, just under two years ago, Professor J. Benoit, of the College de France in Paris, carried out similar experiments on ducks helped by the Reverend Father Leroy, and by Dr. Roger Vendrely and his wife Colette, directors of the biological section of the Strasburg Institute of Macro-molecules. DNA obtained from ducks of the Khaki breed was injected into male and female ducklings of the Peking breed for several months. By the end of the treatment important changes had taken place in the physical characteristics of the ducks. They were neither Khaki nor Peking, but seemed to belong to a new breed having a smooth white plumage and in some cases a rose-coloured beak. Professor Benoit named them "snow whites". Since then the "snow whites" have had many offspring and these have shown the same characteristics as their parents. Despite these results, Professor Benoit maintains that it is still too soon to draw definite conclusions from them and that further experiments are necessary. Photos on this page show: (1) Adult female duck of Peking breed (7 ¾ lbs); heavy body, large head, upright stance, low belly. (2) Male duck of the Khaki breed (4 lbs) which provided the desoxyribonucleic acid with which the Peking breed ducklings were injected. (3) Peking breed duck (5 ½ lbs) which was injected with DNA from the Khaki breed duck when eight days old. The head and body are more slender and the stance is more inclined. The beak is partially coloured black. The plumage is no longer the typical yellow of the Peking breed, but has become discoloured following the injections. This characteristic (absence of yellow pigmentation) was noted among a number of subjects of the succeeding generations. (4) Female duck, the offspring of parents injected with DNA from a khaki duck. This bird, weighing nearly four pounds, was not itself injected. The yellow colouring has now completely disappeared from its beak.

Photos © Michel Berthoumieux

CAN SCIENCE CHANGE A PERSON'S HEREDITY?

GREY & AGING MICE

Many generations of mice have travelled around the sides of this rotating exercise wheel (below) used to determine the effect of exercise on normal aging and on recovery from injury caused by exposure to atomic radiation. The two groups of mice (photo, above) were used in the studies and demonstrate the aging effects of radiation. The mice are all the same age, but the group at the right which turned grey and aged prematurely from exposure to radiation, present a marked contrast to the unexposed group on the left. Studies of this type yield vital data on genetics.

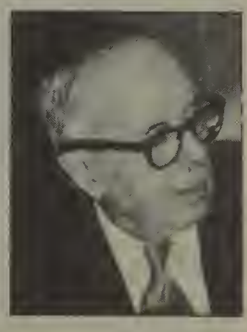
USIS

W. NOYES

WE have long been familiar with the basic laws of genetics. We know that if parents display certain tendencies, their children will in all likelihood inherit these. We know from our experiments with animals that by selecting the parents we can produce among progeny animals with particular characteristics. I am not necessarily suggesting that we should apply this knowledge to the human race, and select those people who should have children and weed out those who should not. That would be rather dangerous, although experiments on those lines have occasionally been made on a limited scale.

There are other things of which we know less. There are certain molecules in the body which could at least give an indication of the future of the race, or indeed determine it. We have molecules that are known to chemists as steroids. There are about thirty of them in the human body. In a more or less normal person, the quantities of these molecules remain in a fixed ratio, but this ratio varies in any person who has a tendency to illness. Can science do anything to keep this ratio constant once and for all?

Heredity is more or less determined by nucleic acids. If a family shows an undesirable tendency, may it not be possible to alter the character of these acids and the relationships between the different groups?



B. HOUSSAY

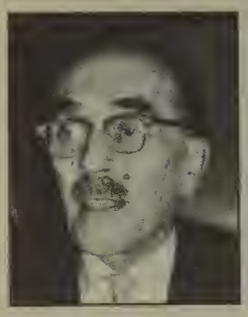
NUCLEIC acids are necessary to maintain cell life, for the formation of proteins, for growth and for heredity. It is well known that if a cell has its nucleus removed, the protoplasm dies and the cell can no longer survive. We also know that the growth of abnormal cells, such as cancer cells, depends on nucleic acids. Several types of medicine used in cases of cancer are effective because they act on the nucleic acids. But it is difficult to make sure that they act only on the nucleic acids of cancerous cells and not on normal cells as well. That is why these types of medicine must be used in moderation, for fear of killing the patient.

Nucleic acids are also to be found in viruses. The active substance of viruses has been crystallized and found to be a super-protein. Division of this substance yielded pure nucleic acids which can be crystallized at will. They retain their properties. They are pure products and can be kept in a jar. If they are used for innoculation, they will reproduce, like a living organism. Following certain experiments, the distinction between a chemical substance and a living organism has gone.

Mutations have been obtained by changing some parts of these nucleic acids. Moreover, we know that chromosomes, which are formed from nucleo-protein, are of basic importance in heredity. We know the particular points in these chromosomes which determine a given characteristic. It has also been possible to interfere with these nucleic acids so as to produce mutations. One of the ill effects of radio-activity is precisely that it modifies these nucleic acids. When this happens, the person affected may have quite abnormal offspring, which is one of the terrible dangers of radio-activity.

These nucleic acids are now beginning to be synthesized. If research along these lines continues successfully, we shall be able to produce substances either to promote or to arrest growth. It will be possible to influence heredity.

EXPLORING THE FRONTIERS BETWEEN INANIMATE AND ANIMATE MATTER



N. SEMENOV

Most people have not yet fully realized what extraordinary possibilities have been opened up by science since the middle of the 20th century, or the tremendous power which it will achieve during the next twenty to forty years.

Never before in history has such a situation existed: mankind now possesses a volume of power so great that if it is used rapidly and wisely it will be possible to satisfy the needs of everyone. The speed of scientific development outpaces the rate of population increase, so that as the major technical and industrial problems are solved, the number of hours each individual needs to work for the benefit of the community will steadily decrease,

Just as machines have already liberated men from hard physical labour, so electronic computers and, in general, the devices of automation and telemechanics which are making prodigious progress, will liberate man from such mental work as is of an essentially, automatic and not creative nature.

Computers of the near future will probably also be able to provide systematized and partially analysed data. Man's creative possibilities will thus be enriched to an exceptional degree; his brain will no longer be burdened with memorizing and pre-analysing a vast collection of facts. Scientists, engineers and economists will thus be able to concentrate their intellects to a much greater extent on purely creative activities. Scientists will no longer be confined to narrow specialization.

Chemistry, in particular, will be faced with some major tasks. If existing chemical processes were more fully applied to agriculture in food-poor countries, this problem would soon be solved, not only for existing populations but also for future ones several times greater.

The chemistry of the future will undoubtedly find new and more effective ways of producing food. It will discover the mechanism of the chemical reactions which take place in an organism under the influence of fermentation, and will show how these principles can be applied industrially; industry will then perhaps succeed in achieving a biosynthesis of food products outside the living organism, using as raw materials albumins and carbohydrates of algae as well as the green matter of plants, and perhaps also lignine. Chlorella, for instance, is an alga which is now attracting great attention in this connexion.

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Continuing research in this way, chemistry will perhaps evolve new types of machines functioning according to the principle of muscular contraction and, with a high coefficient of useful work, directly converting chemical energy into mechanical action. Most remarkable of all is that chemistry, by studying the mechanism of chemical reactions, has started creating new kinds of materials which by now are familiar to most people—synthetic fibres, plastics and rubber, obtained through the chemical treatment of petroleum and coal-tar. These are already found in everyday use on a large scale, in building and in the construction of precision machines.

Thanks to chemistry, the quality of these materials will be progressively improved and their production costs lowered so that they will become the basic materials of the future, suitable for general as well as technical needs. Let us remember that materials are the most stable factors in, and mainstays of, technical progress. It is not surprising that the various eras in the history are named after the materials then used: Stone Age, Bronze Age, Iron Age. Some thirty to forty years ago, the development of chemistry opened up a new era—that of synthetic polymeric materials. Thanks to chemistry, it will be possible to give these materials any qualities desired, so that they will have a wide range of uses, from clothing manufacture to machine construction, in which they will replace metals.

During the last few decades, chemistry has also scored remarkable successes in the field of medicine, including the discovery of cures for once-fatal diseases. A future task of chemistry, in co-operation with biology, is to ascertain the precise chemical mechanism of the action of any particular substance on an organism. This will give a new and powerful impetus to therapeutical chemistry; one of the first results, in my opinion, will be the solution of the problem of cancer.

Probably science's most important task is in the field of chemistry: the interpretation, on a chemical basis, of the transition from inanimate to animate matter, as well as the explanation of the nature of heredity. I am convinced that inanimate matter when it changes into animate matter, acquires new physico-chemical qualities, the discovery and explanation of which constitute chemistry's most important undertaking.

The present development of biochemistry and biology will lead, in the near future, to striking results and will probably result in a scientific and technical revolution no less important than that which came with the discovery of atomic energy. Everything possible must be done to ensure that these discoveries are used for the good of mankind, and not as in the case of atomic energy, for harmful purposes.

D. BOVET

Without entering the field of science fiction, I should like to mention some of the spheres in which research seems to me likely to yield promising results.

Reference has been made to the problems affecting changes in our genetic heritage, nowadays the distinction between inanimate and animate matter does not strike us as such an unfathomable problem. Although we are not yet at the stage of creating life—in fact we are very far from doing so—we are beginning to visualise the hypotheses which should reveal to us just how life first appeared on earth.

Then there are all the problems of nutrition and of the transformation of inorganic matter into assimilable organic matter, which are bound up with the problems of photo-synthesis.

Today we can point without hesitation to a number of problems that have been solved by chemical therapy. It has found a cure for once-deadly diseases which are now practically non-existant or which are rapidly becoming so. Two such examples are cerebro-spinal meningitis, once the dread of all children's doctors, and pneumonia, no longer the danger it once was for old people. Already a century ago vaccination was used to prevent smallpox and serotherapy afforded protection against diphtheria.

The chemical agents now used in medicine, belonging to very different chemical groups, but often having a natural origin, include the very large group of antibiotics. The healing action of these antibiotics is accompanied by the creation of new problems to which many of us have had to turn our attention. These problems are caused by the sudden upsetting of the balance maintained by microbes in the human body, and by the ensuing phenomena of vitamin deficiency, particularly after oral administration of antibiotics. But all these problems are now under study. It is our business to solve them,

'PUSH BUTTON' TOMATOES. Healthy tomato plants flourish under artificial light, are warmed by artificially-controlled temperatures and cooled by artificial rain at the plant research laboratory of the California Institute of Technology. They are rotated on a revolving platform under bands of varicoloured light in what is called the "rainbow" room. A giant electronic panel enables scientists to regulate temperatures by simply pushing buttons. The plants have been found to yield more than those grown outdoors or in ordinary greenhouses.

USIS

BOY OR GIRL? For many years poultry farmers have needed an accurate method of sexing their day-old chicks. A new instrument, the "Sexascope" claims to give 100% accuracy. The principle of the instrument consists of a specially designed tube which is passed into the chick's vent. A light shone through the tube illuminates the rudimentary ovaries or testicles of the chick.

C.O.I., London

NO EARTH, NO SUN. From these single blossoms dropped into test tubes of nutrient solution (above, left), scientists at the plant research laboratory of the California Institute of Technology hope to grow complete strawberries and peas. The plants grow without direct contact with soil, sun or rain and produce more than their country cousins.
USIS

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COBALT THE BOOSTER. At the Institute of Biophysics of the U.S.S.R. Academy of Sciences seeds are exposed to the radio-active rays of radio-cobalt (above, right). The effect is to accelerate the growth of the seeds; the aim is to produce more and bigger harvests.
Official Soviet photo

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POULTRY PROTECTION. A vaccine expert sent to Thailand by the U.N. Food and Agriculture Organization carries out a post-mortem examination of a chicken (right) to determine whether the bird died of chicken Newcastle disease. Some 50,000 fowls were vaccinated and later showed solid immunity to local strains of this chicken disease virus.
FAO photo

H. J. BHABHA

ENOUGH FOOD FOR EVERYONE: A PROBLEM OF KILOWATT-HOURS

We are all used to hearing of the so-called industrially advanced and the under-developed countries. What is implied by this nomenclature? If you look at the countries of the world today you find that there are certain countries, and indeed most of the countries of Asia and Africa, whose national income per head is about $40 to $50 per annum. In the countries of Western Europe the national income per head ranges from $300 to some $900 per annum, while in the United States of America the national income per head is a high as $ 1,800 per annum.

This national income per head is a measure of the well-being of the people of the countries concerned. This, as can be seen from the figures I have given, shows an enormous disparity between the low standard of living of the countries—generally speaking, of Asia and Africa—that we call "under-developed", and the countries of the West,. for example, that are called industrially advanced.

On what is this disparity based? The high standard of living of the industrially-advanced countries is due to a better exploitation of the forces and resources of nature based upon present science and technology. The energy consumption per head in the so-called under-developed countries is the equivalent to the burning of about one-third of a ton of coal per head per annum, whereas in the countries of Western Europe it is eight times as much, and in America it is as much as eight tons per annum per head. This utilization of energy is the basis of the higher standard of living and the higher well-being of these countries.

Now we all owe a great debt and also our cultural values to the ancient civilizations of Egypt, India, China, Greece and later Western Europe. It is important to realize, however, that despite many differences of habits, culture and social pattern, all these civilizations were built essentially on the same foundation. All the energy for doing mechanical work, for tilling the ground, for drawing water, for carrying loads and for locomotion was supplied by muscle, whether human muscle or animal muscle. Molecular or chemical energy, as, for example, obtained by the burning of wood, was only used to a limited extent for cooking and heating and a few technical processes, as in metallurgy.

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It is important to note the severe limitation that the restricted supply of energy puts on the development of civilization. A man in the course of a hard day's work can only produce about half a kilowatt hour of energy, whereas in the industrially advanced countries as much as forty-five kilowatt hours of energy are used per day per head. It follows that a high level of physical comfort and culture could only be enjoyed by a few in the ancient civilizations by concentrating the surplus labour of many for the benefit of a few. In other words, the ancient civilizations of the world were essentially non-democratic. It is only today on the basis of modern science and technology that for the first time we have the possibility of building a democratic civilization and culture.

I recall that on one occasion Lord Boyd Orr said that one man can produce today as much food as ten did fifty years ago as the result of the application of modern science and techniques in agriculture. Now, nobody knows this problem better than he does. In India and in many countries of Asia the productivity of agriculture per man remains the same as it has been for centuries. This shows that a mere application of present knowledge and techniques in these countries could easily solve the food problem in these areas.

It should be emphasized that the food problem of which you hear so much is a marginal one. In years in which the rainfall is good there is no food shortage. In years when the climatic conditions are adverse there is a food shortage. Hence, the manifold increase of the productivity of the soil on the basis of modern techniques could easily ensure that even in bad years there is no food shortage.

Now one important reason for the greater productivity of agriculture is the widespread use of fertilizer such as sulphate or nitrate of ammonia. In India on the average about five kilogrammes of sulphate of ammonia are used per hectare. In England this figure is 200, in Japan 550; in other words, a hundred times as much as in India. It is this lavish use for fertilizer, made possible and produced by modern industrial processes, which is responsible for the greater productivity of the soil. Here we see directly the impact of the chemical industry—namely, the production of fertilizer—on the productivity of agriculture.

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Now the rate at which the production of food can be increased is far greater than the rate at which the population increases, which is 1.3 % per annum in India. I emphasize this point because many people are under the misapprehension that the over-population and the increase of population in the under-developed areas are the causes of their low standard of living. This is clearly not so. Even with an increasing population, modern technology enables one to raise the standards of living of the people as a whole, because the increase in production, the rate of increase in production, is much greater, or can be much greater, than the rate of increase of population.

For example, the population of the United States increases at a rate higher than the rate of increase in India, but nevertheless the standard of living continues to go up because their productivity rises faster. I need not mention the rapid rise of the rate of productivity in the Soviet Union which is phenomenal. It has set a new standard.

The over-populated countries are not India and China —in the sense of the density of population—the density of population is higher in such countries as England and, for example, Belgium. So it is important for all of us to realize that there is a certain responsibility on us to see that modern techniques are applied everywhere for the benefit of these areas. It is not the population problem which is the cause of their low standard of living.

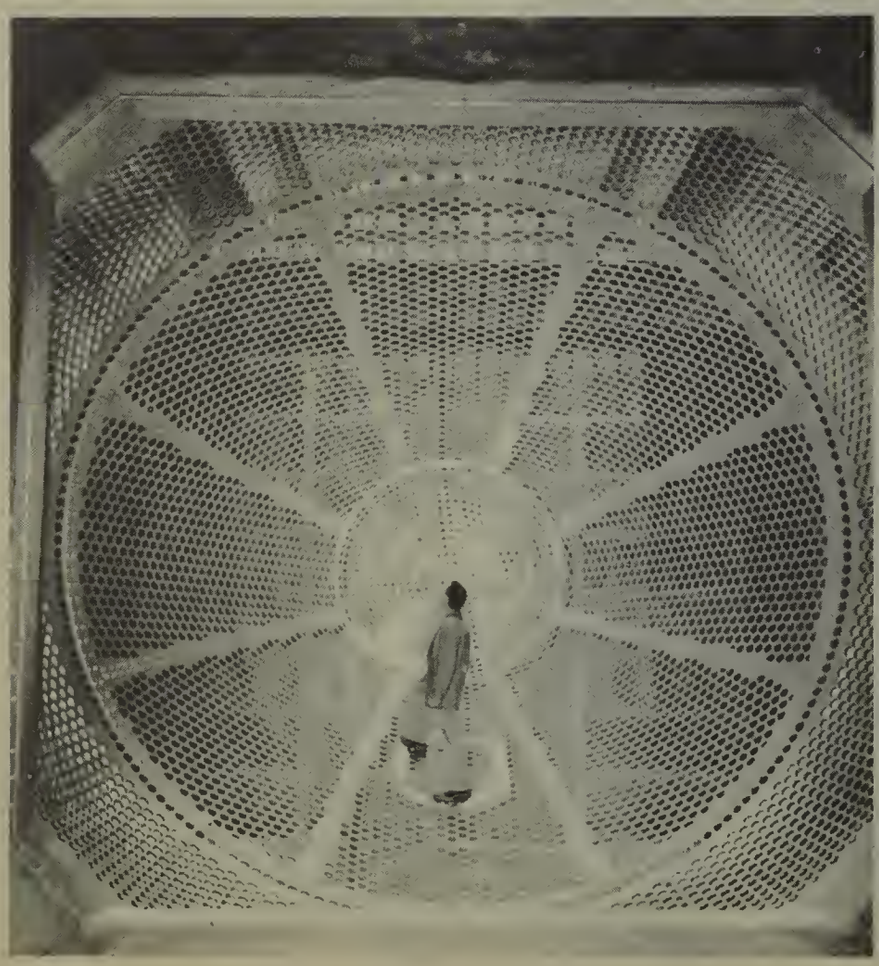
(*Here, Professor Gaston Berger asked Professor Bhabha if he thought that difficulties over the increase of agricultural production were only technical ones—the need for proper machinery and a chemical industry—or if there were not also difficulties due to psychological and social conditions.*)

There are of course, two sorts of difficulties. It is easy enough to erect a steel plant because this requires a certain limited number of highly qualified, technical personnel. To improve agriculture you have to teach practically the entire population, or a greater part of the population, and this is in some ways a much bigger problem. But the problem is also to some extent a matter merely of time. We are, in fact, building a number of fertilizer plants. But there is no doubt that, for the size of the country, the number of such plants and the rate of their construction, should be increased. So this is connected with the general industrial development and what we are now laying the foundation of is not merely fertilizer plants, but factories to produce fertilizer plants, for only in this way can we be independent of outside assistance.

AT THE SPEED OF SOUND IN A TUNNEL

Technicians prepare to test the model of a new aircraft design in a trisonic wind tunnel (right) in the U.S.A. This test chamber, 55 feet long, can be adjusted in height to simulate air speeds ranging from below to above the rate of sound. Equipment photographs and records the results of research. Below, left, a six-foot man is dwarfed by the colander-shaped muffler through which air used for testing model planes is discharged from the wind tunnel. This muffler reduces to a murmur the howling blasts that race through the test chamber. Below, right, a test pilot equipped with special head camera helmet for making aerial films of the flight performances of experimental planes. With a camera mounted on each side of his helmet, he can take pictures by simply aiming his head, leaving his own hands free to handle his controls. This equipment is used on "chase flights" when the cameraman-pilot accompanies another plane to record its flight.

USIS photos



Letters to the Editor

WANTED—A WORLD CALENDAR

Sir,

An article written by Y.G. Perel and entitled "The Calendar and the project for its reform" was published in the monthly popular science magazine of the U.S.S.R. Academy of Sciences. It dealt with the proposals made by India to the United Nations in 1953 for the introduction of a new World Calendar. One wonders why such a remarkable project—so very useful and simple—has been shelved indefinitely.

Could you publish some more detailed information about this proposed calendar and describe how its introduction was debated at the United Nations? If possible I should like to know something about the public's views on this subject.

P.S. Faingold
Moscow, U.S.S.R.

Ed. Note: The possibility of introducing a World Calendar was discussed by the U.N. Economic and Social Council on the basis of reports submitted by 38 *governments. In April* 1956 *the Council expressed the view that the time was not yet ripe for the introduction of such a calendar, and adjourned the discussion* sine die. *It did, however, consider that further studies of the project by the United Nations would be useful. Our reader in Moscow can obtain more details of the discussions from the U.N. Information Centre,* 15 *Hohlovski Pereulok, Apartment* 36, *Moscow. An article on The World Calendar and the history of calendar reform down the ages appeared in our January* 1954 *issue.*

NOTE ON THE RUHR

Sir,

A reader of THE UNESCO COURIER has drawn my attention to the article "One of the Grandest Views of Central Europe", published in the August 1958 issue. In stating "Austria already exports power to Italy and Germany, and other European countries and the Ruhr are prospective future customers" the article creates the impression that the Ruhr is an independent European State. Some of your readers may be interested to know that it is a small river which gives its name to a coal-mining and industrial district within the boundaries of the Federal Republic of Germany.

Dr. Wilhelm Platz
German National Commission for Unesco,
Cologne, German Federal Republic

POCKET HEATER FOR PILOTS

Sir,

As a glider pilot I was most interested by an article in your March 1957 issue concerning the "sausage stove" used by Japanese mountain climbers, the "kairo", consisting of a "sausage" of powdered charcoal which burns for several hours in a simple metal container, and which these mountaineers place in their clothing.

In certain atmospheric conditions gliders are able to reach altitudes varying between 15,000 and 30,000 feet where pilots find the discomfort of extreme cold difficult to stand for hours on end.

I think the "kairo" could be used in gliders where it would provide pilots with a convenient source of heat which they lack today.

A. Cazalas
Paris, France

LANGUAGE BARRIERS

Sir,

Let me say how delighted I am with THE UNESCO COURIER. I anticipate each issue with some excitement and read every number with great satisfaction. Particularly those issues which have dealt with the curse of illiteracy and blight of prejudice have informed me and encouraged me. These are severe and effectual obstacles to intercultural communication.

In this connexion I venture to say that the barrier of language is likewise a stubborn obstacle to the participation of scientists, artists and ordinary men and women in those unique cultural values which each ethnic language represents. It would please me much if you could devote some future issue to the problem of the language barrier.

Floyd Hardin
The International Language Review
Denver 1, Colorado, U.S.A.

OCTOGENARIAN ACHIEVEMENTS

Sir,

I read in THE UNESCO COURIER (October 1958) that Titian began to paint a "Descent from the Cross" at the age of 97. According to the latest researches Titian was born in 1487 and not 1477 as was believed hitherto. If this proves to be right, he worked on his last work at the "early" age of 87. A similar case is A. Stradivarius who possibly was mistaken in indicating his age as 93 on one of his unsurpassable masterworks. It can be that he too was "only" 87 years old when he worked on it.

W.A. Schocken
Tel Aviv, Israel

INGRAINED COSMOPOLITANISM

Sir,

Your magazine disregards the disturbing problem of man's moral capacity and spiritual maturity in the face of the constant growth of his intellectual and material power—a development which you extol throughout your pages. And yet you surely know that according to man's conception of life, according to whether he gives primacy to things spiritual or material, to the group (national or ideological) or to the individual, so will he reap from this growing strength his full development or his own destruction.

Your ingrained cosmopolitanism prevents you from joining this vital debate; if you wished to enter the discussion your prudence would induce you to attempt an impossible conciliation of every belief and philosophy or to unite them in an arid and lifeless syncretism.

I admit that your magazine has been providing me with worthwhile knowledge about scientific and technical progress, but this is something that other specialized reviews offer in greater detail. Furthermore this is merely the outward expression of an inward and vital force which urgently needs to be guided by a taking into account of certain higher values. Your way of lighting up the world is to add more fuel to the fire.

P. Tochon
Paris, France

FORMULA WHICH PLEASES

Sir,

I am very pleased with the formula you have adopted for your review. Your fine photographs relieve the dryness of figures and statistics which would otherwise remain outside the ken of the man-in-the-street, and this would be a great pity for the cause of peace and friendship between peoples.

Ch. Cheno
Montreuil-sous-Bois, France

Sir,

Always keep THE UNESCO COURIER at the present high standard which helps us to round off our knowledge. The culture we gain helps us to comprehend men and facts thanks to the great concern for objectivity and the feeling for different shades of meaning shown by all your contributors. The quality and choice of photographs are generally very high.

M. Bitozzo
Cannes-La Bocca, France

Sir,

Congratulations on the articles of great merit you publish which are of use to everyone. Please do your best to include some on North Africa and the Near and Middle East, dealing, for example, with antique art, the history of these regions and the progress that has been made since countries became independent.

Chahid Abdelaziz
Casablanca, Morocco

From the Unesco Newsroom...

MAGNETIC MAP OF THE EARTH: Countries taking part in the International Geophysical Year have agreed to carry out a world-wide survey of magnetic phenomena at the earth's surface, probably in about five years' time when solar disturbances will be at a minimum and geomagnetic conditions at their most stable. Two hundred observatories now maintain regular magnetic records on land; the main problem in the future survey will be how to make available sufficient non-magnetic ships to obtain measurements at sea. Very few such ships exist at present. Surveys of this kind enable specialists to establish charts needed by navigators and scientists. The last world survey of the earth's magnetism was carried out nearly 30 years ago.

■ **LISTENING IN TO FISH:** *According to S.K. Otoo, a former* UNESCO *Fellowship holder now working with the Bureau of Ghana Languages, "every experienced fisherman in Ghana can recognize the 'voices' of many different kinds of fish, and is able to locate them by a simple yet effective device." The fisherman puts his paddle blade into the water, grasping the handle with his little finger and the lower part of the palm, the other fingers being closed and the thumb placed over them. The fisherman puts his ear to the hollow thus made, and he can hear all the noises going on under the water, including the "voice" of any fish in the area.*

ATOMIC WASTE IN THE SEA: Problems created by the disposal of radio-active waste in the seas were studied by experts recently at the Vienna headquarters of the United Nations Atomic Energy Agency. Discussions covered the prevention of radio-active pollution of the seas due to the peaceful uses of atomic energy, through "controlled" releases of radio-active wastes and also due to accidental escape into the sea of radio-active materials. Results of the study will aid the drafting of a proposed international convention.

■ **INDIA'S GANDHI MUSEUMS:** *Collections devoted to the life and work of Gandhi are to be set up in India, financed by a special fund started in Gandhi's memory. Each museum will have a library of some 10,000 volumes, and the story of the Mahatma's life will be told with the aid of pictures, photographs, photostats of letters, articles and other personal objects. It is also planned to build hostels attached to the museums where scholars from other parts of India or from abroad may stay while carrying out research work.*

MUSICAL ANTHOLOGY OF AFRICAN LIFE

A MUSICAL anthology of special interest was issued recently under the auspices of the International Music Council. Entitled "An Anthology of African Life", the material, recorded on three discs, was collected in the Middle Congo and Gaboon areas of French Equatorial Africa by Herbert Pepper, an ethnologist and musicologist of the French Overseas Scientific Research Organization. The recordings he has assembled go far beyond the purely aesthetic or the merely picturesque. African music is intimately linked with the duties, prayers, rites, games and dances that go to make up everyday existence—hence the title chosen for the work.

The anthology is divided into six parts: scenes of childhood and adolescence; work, marching songs, games; musical language and dances; healing rites, religion, magic; spoken literature; scenes of old age, death and birth.

Detailed information on each recording is given in a richly illustrated brochure, including texts with translations. In a preface, Léopold Sédar Senghor, poet and member of parliament for Senegal, writes: "The title chosen indicates a new approach which aims at a total grasp of reality, as does African Negro art. Herbert Pepper... has left nothing out, neither tears nor laughter, work or play. In Negro Africa, every social activity achieves its fulfilment and effectiveness by virtue of art."

GOVERNMENTS TAKING ACTION TO AID FLOW OF WORLD NEWS

BROADER facilities which will ease the international transmission of news by cable and radio will shortly be put into effect by the world's governments. These concessions result from the 66-nation Telegraph and Telephone Conference of the International Telecommunication Union, held at Geneva last October-November, which adopted a number of proposals recommended by UNESCO for furthering the free flow of information betwen countries.

The conference agreed to telegrams of all kinds being sent "collect"; to reduced rates on jointly leased teleprinter lines and to the establishment of uniform provisions for the operation of teleprinter, telex, telephoto and telephone services in non-European as well as European countries.

Other conference decisions: the provision of wider facilities for radio-communications (multiple address), including permission to incorporate editorial instructions in dispatches; liberalization provisions concerning the identity of persons who may submit or receive press telegrams; the removal of limitations in the application of press rates to press telegrams; and easier leasing of telephone circuits for radio and television transmissions.

The new provisions are due to come into effect on January 1 1960.

MALARIA OUT—RICE IN: Malaria has been almost completely eradicated in Portugal where prior to the last war 15,000 cases were recorded annually, with a toll of 500 deaths. During 1957 there were no deaths and only 49 cases were recorded, while in the first half of 1958 only one case was notified. One result is that Portugal has again become a rice-producing country. Rice cultivation had been forbidden so as to prevent malaria mosquitoes breeding in the stagnant water of the fields. Now, instead of importing rice, Portugal has become an exporter and the savings effected more than cover the cost of the Malaria Eradication Service.

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* World Survey of Education II—Primary Education. Price: $26.00; £6.10.0d; 7,800 Fr. francs.

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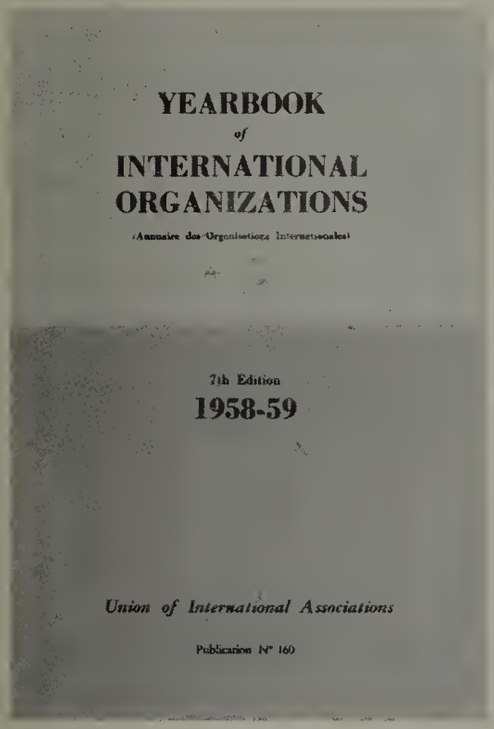

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